9024
600MHz Frequency Meter
Technical Manual

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5th June 2012

Technical manual

9024
600 MHz
Frequency-period
Meter

RACAL
THE ELECTRONICS GROUP

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Frequency-Period Meter
Type 9024

CONTENTS

ILLUSTRATIONS IN SECTION 2

CONTENTS (Continued)

TECHNICAL SPECIFICATION

1.1 FREQUENCY MEASUREMENT

Frequency Range:	10 Hz ta 60 MHz (Direct Goting) Channel B 10 MHz to 600 MHz (Prescaling) Chonnel A
Accurocy:	± 1 caunt ± time bose accurocy
Gate Times:	10ms, 100ms, 1s ond 10s.
Self Check:	Internal 1MHz signal fed thraugh 'B' chonnel.

1.2 PERIOD MEASUREMENT

Range:	10Hz ta 3MHz
Input Channel:	'B'
Periads Averaged:	1, 10, 100 or 1000.
Clack Units:	1μs.

1.3 RATIO MEASUREMENT

Disploy:	On Frequency Mode the Caunter reods: $\frac{F\ (A \text{ or } B \text{ channel})}{F\ (Ext)} \times M$ where M is 1 or 10^3 On Periad Made the Counter reads: $\frac{F\ (Ext)}{F\ (B\ Chonnel)} \times \frac{1}{M}$ where M is 10^3 ar 10^6
Range:	F (Ext) is ony frequency between 1MHz ond 15MHz.

1.4 INPUT 'A'

Frequency Ronge:	10MHz to 600MHz
Sensitivity:	Better than 10mV r.m.s. ta 500MHz (typically better thon 100mV at 600MHz).
Input Impedance:	50 ahms

Signal Range:

Position 1 (without attenuation)

10MHz ta 500MHz : 10mV ta 500mV.
500MHz ta 600MHz : typically better than 100mV to 1V.

Positian 2 (with 20dB attenuation)

10MHz to 500MHz : 100mV to 4V.
500MHz to 600MHz : typically better than 1V to 4V.

Damage Overload:

a.c. > 5V r.m.s.

d.c. The d.c. camponent plus peak input signal must nat exceed 50V.

Input Cannector:

50 ohm B.N.C. frant panel.

1.5 INPUT 'B'

Frequency Range:

10Hz to 60MHz.

Sensitivity:

Better than 10mV r.m.s.
Better than 1mV r.m.s. using Active Probe 819 (option)

Input Impedance:

1M ohm in parallel with 20pF.
10M ohm using 10:1 passive probe.
1M ohm in parallel with 6pF using active probe Type Racal 819 (option).

Channel 'B' Signal Conditions (Valts r.m.s.)

Sensitivity Setting:	0.01	0.1	1.0
Signal Range (valts):	0.01-2.5	0.1-25	1.0-200
Damage Overload:	15V	150V	250V
DC plus peak A.C. Input:	Not to exceed 600V		

Input Connector:

B.N.C. front panel.

Self Check:

Internal 1MHz gated by Channel 'B' attenuator switch (CHECK pasitian).

1.6 TIME BASE

Internal Frequency Standard

Oscillatar Types:	Fast Warm Up Oscillatar Unit:- 5MHz: Type 9400.
Warm-Up Accuracy:	4 minutes for 1 part in 10^7.
Ageing Rate:	Better than 3 parts in 10^9 per day after ane year. Better than 1 part in 10^8 initially.
Temperature Performance:	Better than 7 parts in 10^9 per ^{o}C.

Optianal Oscillatar Type 9420

Ageing Rate:	Better than 1 part in 10^9 after one year. Better than 5 parts in 10^9 initially.
Temperature Performance:	Better than 6 parts in 10^{10} per ^{o}C.

Internal Standard Output

Frequency:	1MHz Sinewave.
Level:	Nominally 1V r.m.s. from 50 ohms source.
Connector:	B.N.C. sacket at rear of instrument.

External Standard Input

Frequency:	1MHz. Minimum level 100mV r.m.s. inta 1k ohm capacitively caupled. Maximum level 10V r.m.s. 400V d.c. Cannectar B.N.C. socket at rear of instrument. External/Internal two position slide switch an rear panel for Standard Selection. The external standard input may be used over the frequency range 1-15MHz, allowing a ratia measurement to be made. See 1.3.

1.7 POWER INPUT

Valtage Range:

110V	(103V - 117V)
120V	(113V - 127V)
200V	(188V - 212V)
220V	(270V - 233V)
240V	(220V - 254V)

	Frequency:	45 - 440Hz.
	Connection:	Three pin moins plug, reor ponel.
	Power Consumption:	60 VA opproximotely.

1.8 DISPLAY

Formot:	Seven digit, in-line, numerical indicotor tubes plus overflow. Disploy lotched-updoted at completion of gote time.
Hold/Reset:	Operotion of the Hold/Reset toggle switch ta up pasition retains the displayed information until released, when the instrument outomoticolly resets to zero ond is reody to cammence o new measurement.
Sample Rate:	The somple rate is determined by twa factars:-
	The length of the gote time and the turn oround time. The turn around time moy be voried fram 250ms ta 10s by means of the front panel Somple Rote control.
Single Shot:	Single shot is ochieved when the somple rote control is switched to 'single shot' ond the Hold/Reset switch is depressed ond then released.

1.9 PRINCIPAL MECHANICAL PARAMETERS

Physicol	Height: case 3.3/8" (86 mm) overall 4.1/16" (104mm) inc.ft.
	Width: cose 16" (407mm) overoll 17.1/8" (435mm)
	Depth: case 14" (365mm) overall 14.3/4" (375mm)
	Weight: Approximotely 19 lbs (8.62 Kg).

1.10 ENVIRONMENTAL CONDITIONS

The instrument conforms to the majority of D.E.F. 133 toble L2 clauses within the following climotic limits:-

Storoge temperature: -40°C to +70°C

Operating temperoture: 0°C to +55°C

Humidity: 95% at 40°C.

1.11 ACCESSORIES PROVIDED

(a) A six foot long, three core mains lead complete with mains socket.

(b) A bag of spare fuses.

(c) A handbook.

(d) Two B.N.C. plugs.

1.12 OPTIONS

NOTE: All Logic Levels are TTL compatible.

Optian 01

Data Outputs

Display information format: 4 line B.C.D. weighed 1.2.4.8. per display digit and 3 line decimal point position.

Function Information: Functian information format: 3 lines binary caded as follows:-

FUNCTION	CODE X Y Z
Frequency	0 0 1
Period	0 1 1

Time base information: 3 lines binary coded as shown.

Format:

Gate Time (frequency measurement)	Code x y z
10 sec.	0 1 1
1 sec.	1 0 1
0.1 sec.	0 0 1
0.01 sec.	1 1 0
Periods Averaged	**Cade** x y z
1000	0 0 1
100	1 1 0
10	0 1 0
1	1 0 0

Overflow: Single line - indicated by '1' level.

Logic Level: '1' state +2.4V to 4.5V } source impedance 180 ahm
'0' state 0V ta 0.4V }

Command Output: +2.4V to 4.5V } source impedance 180 ohm
off level 0 to 0.4V }

Hald/Reset: +2.4V ta 10V (input (impedance (1k ohm apprax.

aff level -20V ta 0.8V (input inta a (reversed biosed (diade

NOTE: Releose af Hald/Reset will couse instrument to automatically reset ond cammence new measurement.

Print Hald: +2.4V ta 10V (input impedonce (1k ahm approx.

aff level -20V ta 0.8V (input inta (reversed biased (diade

Option 02

Remate Programme Operotian - tagether with Dota Outputs os cantoined in Option 01.

Remote Selection: By functian switch an frant panel.

Functian pragramme Farmat: XYZ contral lines os shawn under Optian 01.

'0' input far Frequency
'1' input far Periad Averaging.

Channel Pragramme Farmat: Single cantral line aperated as fallaws:

'1' for A Channel,
'0' for B Channel.

Time Bose Progromme Formot: 3 lines binory caded os shown.

Gote Times (frequency measurement)	Code x y z
10 sec.	0 1 1
1 sec.	1 0 1
0.1 sec.	0 0 1
0.01 sec.	1 1 0
Periads Averoged	**Cade x y z**
1000	0 0 1
100	1 1 0
10	0 1 0
1	1 0 0

Logic Levels required:	'1' stote 2.4V to 10V into 1k ohm '0' stote -20V to 0.8V into reversed biased diode.
Print Hold:	+2.4V to 10V (input impedance 1k ohm approx.)
	Off level -20V to 0.8V (input into reversed biased diode).
Hold/Reset	+2.4V to 10V (input impedance 1k ohm approx.)
	Off level -20V to +0.8V (input inta a reversed biosed diode)

Remote Internal/External Standard Selection.

Single control line: (via REMOTE sacket pin 9)	'1' level external frequency standard. '0' level internal frequency standard.
Logic levels required:	'1' state 2.4V to 10V into 1k ohm. '0' state -20V to 0.8V reverse biased diode.
Optian 04	Alternative frequency standard Racal Type 9420. Refer to para. 1.6 of this Technical Specification.
Option 06	Eight digit readout.

1.13 OPTIONAL ACCESSORIES

(a) A1. Active Probe: Type Racal 819, probe power derived from power socket odjocent to the input sockets, front panel.

(b) A3. Rack mounting kit Racal Part No. 11-0609.

(c) A5. Extension Board kit Racal Part No. 11-0600.

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1.1 The Type 9024 is o compact, lightweight Frequency-Period Meter, styled in the Racol 9000 series image, being slim-line and of full rock width. It has a frequency measuring capability covering the range 10Hz to 600MHz. This is ochieved using two input channels eoch with its own switched ottenuator. Signols in the range 10MHz to 600MHz ore applied to the Channel 'A' input where a Pre-Scaler Assembly of advanced design provides decode division. The Channel 'B' input is used when meosuring frequency in the range 10Hz to 60 MHz, ond olso for Period Meosurement in the ronge 10 Hz to 3 MHz.

CONTROLS

1.2 Separate Sensitivity Controls are provided for Channels 'A' and 'B', the sensitivity levels (in volts r.m.s.) ot each setting being engroved in block and the moximum input levels in red. The slide switch at the centre of the input ponel is the Channel Selector which should be set towords the particular input socket in use. The display time can be varied by the SAMPLE RATE control which, when turned to the extreme onti-clockwise position, operates a switch which provides a 'single shot' facility. The odjacent HOLD/OPERATE/ RESET switch allows the display to be held at will, or, if briefly depressed to the RESET position, produces o new meosurement, o focility which is useful when operating in the SINGLE SHOT mode or on long display time. The POWER switch hos a STANDBY position which allows continuous operation of the frequency stondord oscillotor whilst the a.c. supply is connected.

CONNECTIONS

1.3 Input signals are applied via BNC front panel sockets. Both channels have an input sensitivity af 10mV r.m.s.; on Channel 'B' however, this can be increased to 1mV by use of the Racal Active Probe Type 819, for which a front panel power outlet is provided. Sockets ore provided on the rear panel for external standard input and 1MHz reference autput, the required facility being selected by an adjocent switch.

FREQUENCY STANDARD

1.4 The oscillator unit is one of the Rocal "Fost-Warm-Up" range, which provides a high level of accuracy, and, by pre-ageing of the crystal befare assembly, is assured of very stable characteristics. With mains supply connected the oscillator runs continuously, thus providing a sinusoidal 1MHz, reference frequency at the rear panel even though the instrument is otherwise not in use. An external frequency standard can be connected to the instrument; for normol meosurement purposes this should be at 1MHz with on accuracy and stability not inferior to the internal oscillator, however, to pravide a "ratio" facility the external standard input moy be varied over the range 1 to 15MHz. Provision is made in the 9024 for remote selection of either internal or external frequency standard by means of logic signals applied to the Oscillatar Assembly. A convenient connecting point for control signals is provided in the Remote Control socket when Option 02 is fitted.

READOUT

1.5 The seven digit, in-line, 'lotched' disploy incorporating outomatic decimal point positioning, enables the instrument to resolve measurements to 0.1Hz on the longest of the four available gate-times (10 ms, 100 ms, 1 s and 10 s) which ore selected by the rotory function switch mounted on the front panel. Associoted with the display is an Overflow Lomp which illuminates when the counter overflows, i.e. when the disployed reading is in excess of "oll nines". At customers option an additional readout assembly can be fitted to provide on 8-digit reodout. (Option 06).

CONSTRUCTION

1.6 The case is constructed of duroluminium with ventilotion slots in upper ond lower surfoces. Four feet project from the rear face, thus permitting the instrument to be placed in the upright position with protection for panel-mounted components. The hondle, which is pivoted ot the sides of the case, moves through an arc of opproximotely 135°. In the verticol position it serves as a corrying hondle, or con be set at 90° to the front ponel for use os o bench stand.

1.7 Mechonicol design is modulor, almost all camponents being mounted on printed circuit boards (p.c.b.'s). Each assembly is identified by a six figure assembly number, and these numbers provide a convenient basis for the arrangement of parts lists ond circuit diograms in the handbook. An ossembly identified by o number commencing with 11- (for exomple 11-0565) is a composite assembly cansisting of one or more p.c.b.'s together with other items such as switches etc. not maunted an a baard. An ossembly which consists only of a single p.c.b. will have on assembly number commencing with 19- (e.g. 19-0379).

REMOTE CONTROL

1.8 Option 02 provides for remote programming af the 9024 using binary coding as detoiled in the Technical Specification paragraph 1.12. The use of 3-line coding for the time bose programme is o valuable design feature, used throughout the Rocal 9000 series of counters, which ollows ony one instrument to slave (remotely control) onother. Mechonicol details of the ovailable options are contoined in on oppendix at the reor of the hondbook. It may be noted that when Option 02 is fitted it olso includes the B.C.D. Dato Output (Option 01).

CHAPTER 2

PREPARATION FOR USE

INTRODUCTION

2.1 To ensure correct use of the instrument the user is recommended to read the notes on front ponel controls in Chapter 3 and the Brief Technicol Description in Chapter 4 before setting to work.

POWER AND EARTH CONNECTIONS

2.2 (1) Unpack the instrument and exomine for ony indicotion of physicol domoge. If it is desired to remove the case refer to paragraph 2.3 in this Chopter.

(2) Set the voltage adjuster on the rear ponel to suit the mains supply voltage.

(3) Ensure thot the Power Fuse on the rear ponel is of the correct value for the moins supply voltage. (100/130V = 500 mA, 190/250V = 250 mA). The fuse must be of anti-surge type.

(4) Connect the instrument to the moins supply. The cable is colour coded os follows:-

Brown lead ..... to line
Blue lead ..... to neutrol
Yellow/green lead ..... to earth (ground)

(5) With the instrument POWER switch to STANDBY switch on the mains a.c. supply ond check that the amber "Standby" lomp illuminotes.

REMOVAL OF CASE

2.3 (1) Disconnect the pawer coble from the rear ponel.

(2) Stond the instrument face downwards on the bench. Slocken off the four captive screws locoted in the plastic feet on the rear panel, using a large size "pozi-drive" screwdriver.

(3) Lift off the cose.

FUSELINKS

2.4 Table of Fuselinks. Refer to page 2-3. Refer to Fig. 2.7 at the end of Chapter 6 for internal fuse location.

SELF-CHECK PROCEDURE

2.5 This check should be carried out when first using the instrument and periadically thereafter.

(1) Check that the power supply connections are correct (para.2.2) and that the amber standby lamp is illuminated. Allow a 3 minute warm-up time.

(2) Set the instrument POWER switch to POWER ON, and note that the amber standby lamp extinguishes. The numerical indicator tubes in the display windaw shauld display digits.

(3) Put the HOLD/RESET switch to its centre positian and turn the SAMPLE RATE knob fully clockwise.

(4) Set the CHANNEL 'B' SENSITIVITY switch to the CHECK position and the slide switch above the Probe Power socket to CHANNEL 'B'.

(5) Ensure that the EXT/INT switch on the rear panel is set to INT (dawn).

(6) Check the display against the Function switch positions in accordance with the follawing table, for 8-digit option see NOTE below.

TABLE 1

FUNCTION/RANGE SWITCH		DISPLAY	REMARKS
kHz	(10 secands)	000.0000 ——→	Overflow lamp ON
MHz	(1 second)	1.000000	
MHz	(0.1 second)	01.00000	Talerance on
MHz	(0.01 second)	001.0000	all readings
mS	(1000 Periods)	0.001000	± 1 count
mS	(100 Periods)	00.00100	
mS	(10 Periods)	000.0010	Check that decimal
S	(1 Period)	0.000001	point illuminatian is
REMOTE		0000000	correct at each setting.

NOTE: With 8-digit aptian (06) the 8th digit indicates '1' on the 10 second gate and the Overflow lamp does not illuminate.

(7) Vary the SAMPLE RATE control and check that display time varies accordingly.

(8) Check that the HOLD/RESET switch is functianing correctly. Press dawn and release and check that the instrument resets to zera and cammences a new measurement. Press up and check that the display is retoined while the Functian switch is maved.

USING AN EXTERNAL FREQUENCY STANDARD (See also para 2.8 overleaf)

2.6 (1) Put the EXT/INT switch an the rear panel to EXT.

(2) Connect the 1 MHz frequency standard (naminal level 1 Valt r.m.s.) ta the caaxial socket an the rear panel.

(3) Operate the instrument as instructed in para. 2.5, allawing a suitable warm-up time far the external oscillator.

REMOVAL OF PLUG-IN BOARDS

2.7 A pair of Racal board extraction levers are provided with each instrument. These are designed to engage with holes in the printed circuit boards and, by a levering actian, a board can be eased aut af the edge cannector. Take care to raise the board evenly to avaid pin distortian.

TABLE 2 - FUSELINK DATA

Circuit Reference	Functian	Fuse Rating	Racal Part Number
FS1	+200V	60mA	23-0000
FS2	+12V	750mA	23-0005
FS3	+5V	1.5A	23-0007
FS4	+12V (crystal aven)	500mA	23-0004
FS5	-12V	500mA	23-0004
FS6	Mains Input (Rear Panel)	250mA (190-250V)	23-0031
		ar	
		500mA (100-130V)	23-0022
NOTE: Mains fuse must be anti-surge type			

REMOTE PROGRAMMING OF FREQUENCY STANDARD

2.8 A connection to the Frequency Stondord EXT/INT switch permits remote selection of either internol or externol oscillotor. The necessary doto is contoined in the Technicol Specificotion page (9) and o description is given in Chopter 5 paro 5.17. When Option 02 is fitted the oppropriate control connection is via pin 9 of the REMOTE socket. Note thot for remote control the EXT/INT switch must be set to INT.

CHAPTER 3

OPERATING

DESCRIPTION OF CONTROLS

3.1

POWER ON and STANDBY Switch: A toggle switch, which in the 'up' position completes the +220V and +12V d.c. outputs from the power unit to the Motherboard. It should be noted that the a.c. supply is not switched, therefore dangeraus voltages are present in the instrument sa lang as it is connected to an a.c. supply. In the STANDBY position of the switch the +12V remains connected to the frequency standard oscillator assembly as indicated by illumination of the STANDBY lamp.

Input Channel Selector Switch: Two position slide switch which selects Channel A or Channel B input.

Function Switch: This is a rotary switch which selects 'gate time' for frequency measurement and "number af periods averaged" for period measurement. Against each setting is engraved the units in which the display should be read.

The REMOTE positian af the switch enables the 'gate time' and 'periods averaged' functions to be programmed from a remote stotion, with remote indication of readout.

SENSITIVITY Switches: Also referred to as the Attenuator Switches, Channel A (10 MHz - 600 MHz) control selects two levels of attenuation giving input sensitivities of 0.1V and 0.01V r.m.s. for frequencies up to 500 MHz, for frequencies above 500 MHz the input sensitivities are 1V and 0.1V r.m.s. Channel B (10 Hz - 60 MHz) control selects three levels of attenuation giving input sensitivities of 1V, 0.1V and 0.01V r.m.s.

The red figures indicate the absolute maximum signal levels (r.m.s.) which may be fed into the instrument at each level af sensivitity.

In the CHECK position the external signal input is disconnected and the 1 MHz signal from the frequency standard is fed through the counting stages to provide a self-check facility.

SAMPLE RATE Control: A combined potentiometer and switch. Turned clockwise it reduces the duration of the display time and gives an increased sampling rate. Turned fully anti-clockwise until the switch aperates, it then halds the display and prevents further updating except by use of the RESET position of the HOLD/RESET switch.

HOLD/RESET Switch: A three-position toggle switch. The central pasition is the narmal operating mode. By depressing the switch,"Reset" will occur allowing a new measurement ta be made and displayed. This is useful when operating on Single Shot or on long display time. The upper (HOLD) position enables the operator to 'hold' the display at any time without having to select Single Shot.

Display Contrals

3.2 The following notes will summarize the relationshi p between the various controls affecting the display. The rate at which measurement samples are taken is determined by:-

(a) The duration of the gating period.

(b) The turn round time which may be varied between 10 seconds and 250 milliseconds by turning the SAMPLE RATE control in a clock-wise direction.

Automatic updating of the display will cease when the SAMPLE RATE knob is turned fully anti-clockwise and clicked into the SINGLE SHOT position, a condition under which a new reading may be obtoined by momentarily depressing and then releasing the HOLD/RESET switch. If put to the 'up' position the HOLD/RESET switch will hald the digits in the display irrespective of other controls, but it should be noted that if the FUNCTION/RANGE switch setting is altered, the decimal point will move. In all circumstances other than 'Hald' whenever the FUNCTION/RANGE switch setting is altered the instrument will 'clear-down', re-sample, and display a new reading.

Rear Panel Items

3.3 On the reor ponel ore mounted the moins power plug, moins fuse and voltoge selector. Provision is mode for fitting the optionol Data and Remote Programming outlets. A slide switch morked EXT/INT permits selection of frequency standard input ar autput. In the EXT position on external 1 MHz stondord may be cannected to the odjocent EXT FREQ. INPUT socket, the internal oscillator being disconnected. In the INT positian o near sinusaidal 1 MHz autput derived from the internal standard is avoiloble at the adjacent 1 MHz OUTPUT socket.

OPERATING PROCEDURES

INTRODUCTION

3.4 Refer to Chapter 2 ond check that the Pawer connectians hove been carrectly mode. Corry out the Self-Check Procedure to be ossured of satisfoctory performance. (Para. 2.5).

FREQUENCY MEASUREMENT

3.5 (1) Allow not less thon 3 minutes worm-up time on STANDBY.

(2) Switch to POWER ON. Note that the Stondby lamp extinguishes and thot disployed digits oppear in the readout.

(3) Set the SAMPLE RATE and HOLD/RESET controls as required.

(4) Set the SENSITIVITY - VOLTS switch to 0.1 for Channel A (10 MHz - 600 MHz) input or 1 for Chonnel B (10 Hz - 60 MHz) input.

(5) Connect the signol to be meosured to the oppropriote Chonnel A or Chonnel B socket.

(6) Set the Input Chonnel Selector slide switch to the required 'A' or 'B' position.

(7) Set the FUNCTION switch to the required Gote-Time. (See (9) belaw).

(8) The frequency of the input signol should now be disployed on the readout. If o satisfoctory disploy is not obtained on Channel A input re-check the display with SENSITIVITY ot 0.01. If a

satisfactory display is not obtained on Channel 'B' input re-check the display with SENSITIVITY at 0.1 and once again, if necessary, at 0.01. If a satisfactory display is still not obtained, check that the level of the input signal is not lower than 10 mV r.m.s.

(9) When using gate times of long duration the count may overspill (OVERFLOW lamp illuminates). Take a reading using a shorter gate time to determine the most significant digits, and then use the longer gate times to obtain a high resolution.

(10) To hold the display, set the HOLD/RESET to HOLD.

NOTE: Below 10 kHz, greater accuracy may be obtained by measuring the average period over a number of cycles and calculating frequency.

AVERAGE PERIOD MEASUREMENT

3.6 This mode is recommended for measuring low frequencies in the range below 10 kHz and for short repetitive time intervals.

3.7 The incoming unknown signal is taken to the time-base decade dividers, the output from which, selected by the PERIOD position of the Function switch , is used to gate the internal frequency standard to the counter decades.

(1) Select the number of periods to be measured by setting the Function switch to :- 1, 10, 100 or 1000.

(2) Set the Channel Selector slide switch to CHANNEL 'B'.

(3) Connect the unknown signal to the CHANNEL 'B' input socket.

(4) Set the SAMPLE RATE control to give a suitable display time.

(5) When averaging over a large number of cycles to obtain higher resolution, the count may overspill the display in which case a second reading averaged over fewer cycles to determine the most significant digits should be taken.

NOTE:1: The display indicates the actual value of the period of the incoming signal. Note the unit (μs or ms) which corresponds to the position selected on the Function switch.

NOTE:2: At lower frequencies, the trigger error becomes significant. Its effect can be minimised by averaging over many cycles with overspill, and reducing the result to six significant digits.

OPERATION WITH ACTIVE PROBE (CHANNEL B)

3.8 By using the Racal Active Probe Type 819, the sensitivity of the instrument is improved to 1 mV r.m.s. on Channel B.

(1) Connect the power supply lead of the 819 Probe to the 3-pin outlet marked PROBE POWER on the front panel of the 9024.

(2) Connect the signal output lead of the 819 Probe to the CHANNEL B input socket of the 9024.

NOTE: A separate handbook is available for the 819 Probe.

CONNECTION OF EXTERNAL FREQUENCY STANDARD

3.9 On the rear panel set the EXT/INT switch to EXT, and connect the 1 MHz source (not lower than 0.1V into 1kΩ) to the socket EXT FREQ. INPUT. It should be borne in mind that the accuracy of the frequency standard will have a direct effect on the precision of measurement made by the counter. The instrument will accept an external frequency standard in the range 1 to 15 MHz, thus providing a ratio measurement facility.

1 MHz OUTPUT

3.10 The internal 1 MHz reference frequency is available as a nearly sinusoidal output at the rear panel socket ' 1MHz OUTPUT '. The adjacent switch must be set to INT.

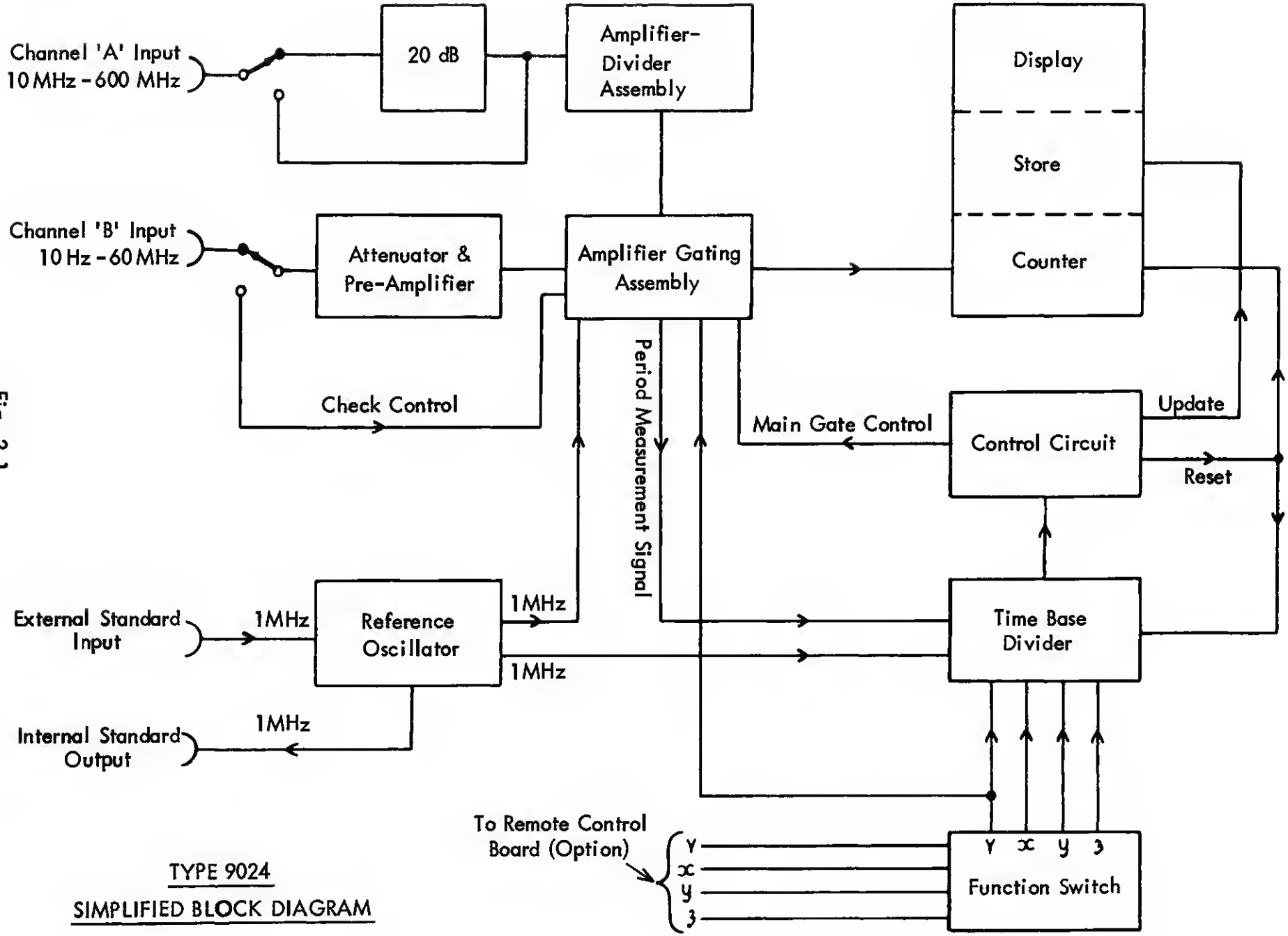


Fig. 2.1

TYPE 9024

SIMPLIFIED BLOCK DIAGRAM

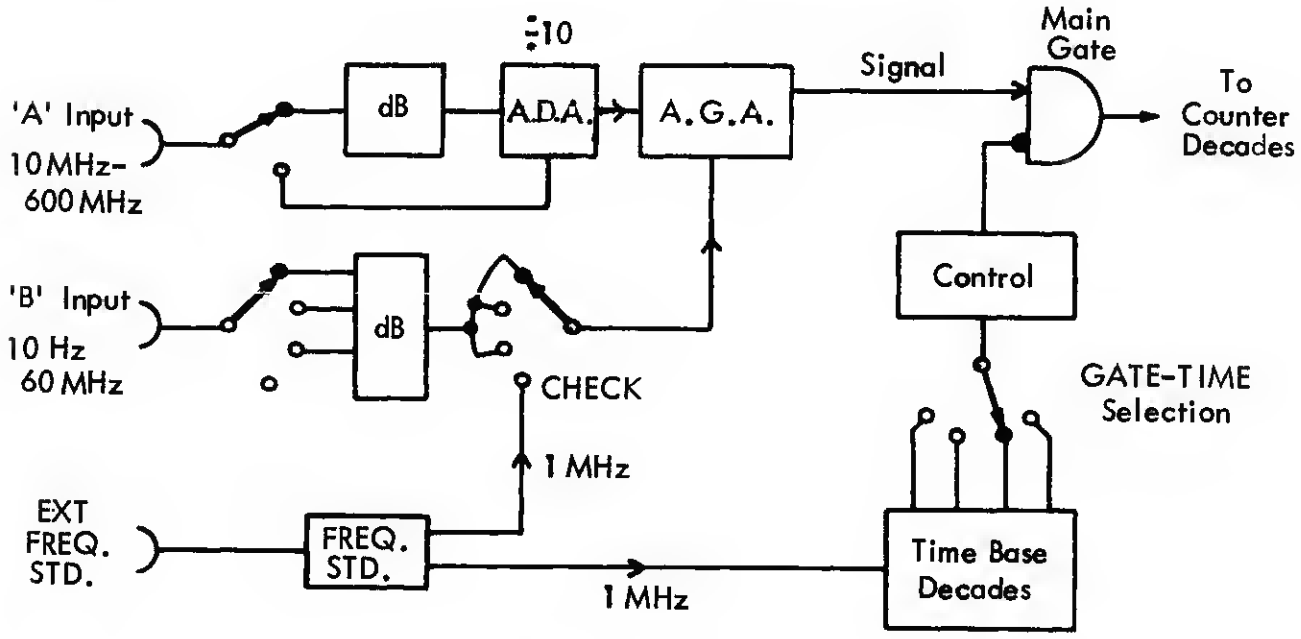
CHAPTER 4

PRINCIPLES OF OPERATION

FREQUENCY MEASUREMENT

Fig. 2.2

4.1 The instrument measures frequency by counting the cycles of an input signal for an accurately known period of time. Two signal inputs are available, signals from 10 MHz to 600 MHz are applied via input socket 'A' to the Amplifier Divider Assembly (19-0630), 20 dB attenuation may be switched in if required and is provided by Attenuator (11-0620). Signals from 10 Hz to 60 MHz are applied via input socket 'B' and the rotary sensitivity switch to the Attenuator and Pre-Amplifier (11-0339). When the main signal gate in the Amplifier Gating Assembly (19-0379) is opened by a 'Gate Time' signal from the Timebase (19-0352) the unknown signal is released to the counting decades for a precise time interval determined by the Gate Time setting of the Function switch. At the end of the gating period the count is stopped and the total is transferred via the Readout stages (19-0450) to the numerical display lamps. The total is displayed on the indicator lamps for a time interval determined by the setting of the SAMPLE RATE control. Then, unless HOLD or SINGLE SHOT has been selected, the counter will reset, clear the display to "all zero's" and repeat the cycle of operations. All timing processes are referenced to the very stoble 1 MHz signal derived from the Frequency Standard oscillator.



Frequency Measurement Fig. 2.2

SELF-CHECK

4.2 In the CHECK mode the instrument operates as for frequency or period measurement except that the 1 MHz signal from the Frequency Standard takes the place of an unknown signal at the input to the A.G.A. Thus a readout of 1.000000 ± 1 count confirms that the instrument measuring circuits are serviceable.

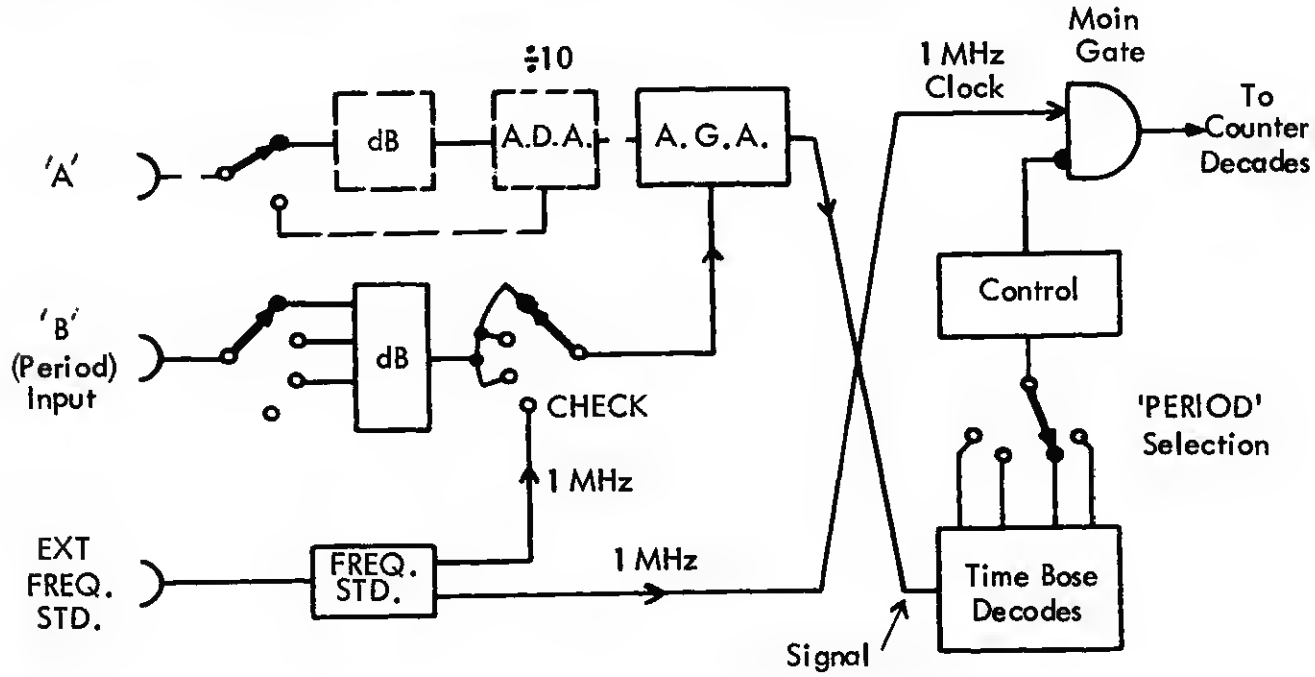
PERIOD MEASUREMENT

Fig. 2.3

4.3 In the Period mode the unknown signal is used to control the gating time and the clock pulses from the frequency standard are counted during one or more cycles of the unknown signal. Greater accuracy is obtained by measuring over as many cycles as possible. The readout displays the clock pulses counted during an average period and the units of the display are as engraved against the selected position of the Function switch.

4.4 Referring to Fig. 2.3 below, it is seen that the signal of unknown frequency from input socket 'B' is shaped and applied to the Timebase decades. In the Timebase the unknown signal generates a selection of gate waveforms, one of which is selected by a PERIOD position of the Function switch. The chosen gating waveform is applied to the main gate to control the number of cycles during which the measurement is taken.

4.5 Clock pulses from the Frequency Standard are fed to the signal input of the main gate and are counted in the counting decades during the time interval controlled by the selected timebase output. The displayed readout is the average period of the unknown signal which can be converted to frequency by a simple calculation.



Period Measurement: Channel 'B' Fig. 2.3

TIMEBASE and CONTROL

4.6 The Timebase Divider consists of a number of integrated circuit decades which divide down the applied input to the board to produce the timing signals necessary for the various functions and ranges of the instrument. Selection of the required output from this board is achieved by a combination of gates which are primed by the binary coded output from the Function switch. Signals from the Timebase Divider govern the Control Circuit which in turn opens ond closes the Main Gate, and produces the Reset and Update command signals.

FREQUENCY STANDARD

4.7 A Racal Fast warm up oscillator of either 5 MHz or 10 MHz type may be fitted. The ascillatar output being divided down to 1 MHz in the oscillator p.c.b. assembly and this reference frequency determines the accuracy af all timing process within the instrument. The oscillator is a plug-in unit and bearing in mind that the accuracy and resalutian af the instrument is directly related to the accuracy of the frequency standard, it is recommended that a replacement unit be fitted if a fault occurs. Link facilities in the p.c.b. assembly enable either a 5 MHz or 10 MHz oscillator ta be used as a direct replacement. The connections to the oscillator unit are very accessible and a simple test procedure is given in the Maintenance instructions. Servicing af the ascillator shauld be carried aut by Racal Instruments Ltd., or by an authorized repair agency.

CHANNEL SELECTION

4.8 Since both Channel A and Channel B inputs are fed to a common stage in the Amplifier Gating Assembly, it is necessary to disable the amplifier which is not in use. This is the function of the Channel Selector switch S5 (see Fig. 4.23) which connects the +12V supply to the appropriate A or B amplifier assembly (either 19-0630 or 11-0339).

4.9 When the Remote Control Option is fitted certain links are removed and the relay RLA (Fig. 4.23) performs the channel selectian function. The relay coil being energized from +12V within the instrument via pin 19 of the Remote Control Assembly (19-0628) and pin 7 of the Remate Control socket where the applicatian of a lagical '1' selects Channel A and a '0' selects Channel B.

CHAPTER 5

TECHNICAL DESCRIPTION

ATTENUATOR AND PRE-AMPLIFIER 11-0339 (CHANNEL B) Fig. 4.1

5.1 The Attenuator and Pre-Amplifier Assembly is contained within a screening box and mounted behind the B Channel SENSITIVITY switch on the front panel. The circuit is shown in Fig. 4.1 and will be seen to consist of two separate printed circuit boards, 19-0235 and 19-0236, together with the switch.

5.2 The Attenuator Assembly 19-0235 is shown within the chained line on the left of the diagram and consists basically of a resistor potential divider network. The resistors alone determine the attenuation at low frequencies, but correct attenuation at high frequencies is achieved by the adjustment of the trimmers C3 and C5. The outputs from contacts 2, 3 and 4 of the printed circuit board represent 0 dB, -20dB and -40 dB respectively.

5.3 The chained line to the right of the diagram encloses the circuit of the Pre-Amplifier Assembly 19-0236. The signal level selected by the SENSITIVITY switch S1b is a.c. coupled via C9 to the gate of the field effect transistor Q1, the bias for which is obtoined from the 6.8V zener diode D3. Across the input circuit the limiting arrangement of D1, Q6, D2 and Q7, clips both positive and negative excursions of the applied signal. The transistor Q2 acts as the constont current source for the FET, whilst the transistor Q3 may be looked upon as a shunt feedback amplifier. This whole input configuration provides a well defined gain coupled with a low input capacitonce and high input resistonce.

5.4 Signals developed across R9 are a.c. coupled via C12, C24 to the base of Q4, the first transistor in the long-tailed pair formed by Q4 and Q5. Further clipping action from D5, D6 improves the shape of the signal presented to Q4. The signal developed across R20 is applied via the zener diode D7 to the first stoge of the Amplifier Gating Assembly. The +12V supply to the amplifier board is supplied via the Channel Selector switch on the front ponel of the instrument.

ATTENUATOR 19-0620 (CHANNEL A) Fig. 4.17

5.5 Input signals in the frequency range 10 MHz to 600 MHz are fed via input socket 'A'. The slide switch offers a choice of a direct signal path to the Amplifier Divider Assembly, or 20 dB attenuotion by a conventional attenuator network.

AMPLIFIER DIVIDER ASSEMBLY 19-0630 Fig. 4.21

Input Amplifier

5.6 The signal from the Channel 'A' Attenuator Assembly enters the Amplifier Divider Assembly at SKT1, with an input impedance of 50Ω and is applied to the amplifier formed by transistors Q1, Q2, Q3 and Q4, which has a nominal overall voltoge gain of 14. Adjustment is provided at C3 and C8 for high-frequency compensation to ensure adequate gain over the entire frequency range of the instrument.

Shaping

5.7 From the amplifier output at Q4 signals are fed to the shaper circuit consisting of transistor Q6 and tunnel diode D2. When fitting a new tunnel diode to the p.c.b. it is vitol that the correct soldering procedure is fallawed (see Chapter 6, para 6.25). The bias on Q6 is set by transistor Q5 with preset adjustment by R24. The signal across D2 is fed to Q7, and after further amplification, into the divide-by-ten integrated circuit package IC1. The divided output is amplified by Q8 and applied to Q9 and Q10. The output from emitter follower Q9 is token to the Amplifier Gating Assembly 19-0379. An additional output from emitter follower Q10 is available but is not used in this instrument. The +12V supply to the assembly is supplied via the Channel Selector switch on the front panel of the instrument.

AMPLIFIER GATING ASSEMBLY 19-0379 (A.G.A.) Fig. 4.10

5.8 Signals from the 'B' Channel Attenuator and Pre-Amplifier enter the A.G.A. via pin 7 whilst signals from the Amplifier Divider Assembly (Channel A) enter vio pin 23.

5.9 The first four transistors in this circuit comprise a two-stage amplifier. The emitter follower Q1 offers a high input impedance to the applied signal and acts as a buffer between the input and the first voltage amplifier Q2. Low frequency decoupling from the emitter of Q2 is by C13, whilst high frequency peaking is by adjustment af C11. The diodes D4 and D5 limit the input to the base of Q3. Emitter follawers Q5 and Q8 act as buffer stages on either side of the Schmitt Trigger formed by Q6, Q7; R25 effectively adjusts the bias to provide a sensitivity control for the trigger, while D11 campensates for effects of temperature on the bias point. The zener D9 provides fast switching within the Schmitt circuit and bead X4 in the emitter of Q8 damps the overshoot. The resultont output is differentiated by C26, and the pulse train leaving the collector of Q9 is now offered two alternative paths, as it is applied to bath the base af Q10 and the base of Q12.

Frequency measurement

5.10 When the Function switch is turned to any one of the four FREQUENCY positians the Y input goes to a '0' level, and reaches the base af Q11 via pin 16 of the printed circuit board, Q11 is turned off permitting the output from Q10 to reach the base

of Q14. At the same time the '0' level entering pin 16 is inverted by the transistor Q19, the resultant '1' level being applied to the bases of Q13 and Q17 respectively, clamping the outputs from Q12 and Q18.

5.11 The main gate on this ossembly is formed by the transistors Q14, Q15, and Q16. The gate is opened by a '0' level from the Control Circuit Assembly which enters the circuit on pin 12 and is applied to the base of Q16. Under these conditions the output pulses from the emitter follower Q20 ore fed directly to the counter. When a '1' state is received from the Control Circuit Q16 will turn on, the collector of Q14 is clamped to 0V which closes the gate and cuts off the signal flow to the counter.

Period Measurement

5.12 When the Function switch is turned to any one of the four PERIOD positions, pin 16 will receive a '1' level, turning on Q11 and Q19. The output from Q10 is now clamped to 0V, which diverts the incoming signal through Q12 and out via pin 15 to the Timebase Divider. The '1' state inverted by Q19 not only turns off Q13 (to enable Q12) but also turns off Q17, removing the clamp from Q18. This allows the 1 μs clock pulses from pin 17 to reach the base of Q15. From here they will pass into the counter via Q20 in accordance with '0' and '1' states applied to the base of Q16 by the Control Circuit.

5.13 The '1' level now on pin 16 for period measurement is applied to the base of a third transistor Q21, having the effect of bringing C29 into circuit, which reduces the upper limit of the amplifier's bandwidth to 3MHz.

Check Signal

5.14 With the rotary SENSITIVITY switch set to any of the three Sensitivity positions and with "Channel B" selected, pin 3 on the A.G.A. is open circuit, which results in a reverse bias being applied to diode D1. Turned to the CHECK position the input signal is disconnected from pin 7 (S1B Fig. 4.1) and pin 3 is taken to -12V (S1Ba Fig. 4.1). In this condition the 1MHz signal from pin 17 is applied via R54, C2 and the now conducting D1 to the collector of Q2 and used as a check signal. The 1MHz square wave from pin 17 is attenuated and shaped by R54 and C2 in conjunction with C3. The decoupling from R1 and C32 prevents the 1MHz signal from passing into the Attenuator and Pre-Amplifier Assembly.

FREQUENCY STANDARD OSCILLATOR ASSEMBLY Fig. 4.2

Introduction

5.15 The Oscillator Assembly consists of p.c.b. 19-0636 together with a fast-warm-up oscillator unit. The EXT/INT switch mounted on the rear panel permits selection of either internol or external frequency standard source. In earlier models the oscillator unit was mounted on an Assembly with the p.c.b., but in later versions the oscillator is attached to the inner face of the reor panel with odjustment access via a hole in the panel. In the event of an oscillator fault it is recommended that the unit be returned to Racal Instruments Ltd., or authorised agent.

External/Internal Standards

5.16 Sockets on the rear panel make provision for a 1MHz reference output derived from the frequency standard and also for the connection of an externol 1MHz reference source. Operation from internal or external standard source may be chosen by manual setting of the EXT/INT switch, or by remote programming.

Remote Programming

5.17 With the EXT/INT switch set to INT the frequency standard source may be programmed by logic levels applied to pin 9 of the rear panel REMOTE socket, as follows:-

Logic '1' will select 'external' standard source.
Logic '0' will select 'internal' standard source.

Logic levels required are:-

'1' state +2.4V to +10V into 1kΩ
'0' state -20V to +0.8V reverse biased diode.

Internol Standard Operation (refer to Fig 4.2)

5.18 The internal oscillator output is fed via the shaper circuit to Q3 and pulse amplifier Q5 to the decade divider IC1 which is wired in a ÷5, ÷ 10 configuration.The divided output must be 1MHz, thus with a 5MHz oscillator the link LK1 will be connected to select the ÷5 output.

5.19 Gating. With switch SW1 at INT, Q6 will be turned off, the resulting '1' at IC2a pins 1 & 2 producing a '0' at IC2d/12. Due to the '0' on IC2d/12, logic '1' is applied to IC2c/10 which opens the gate IC2c. As IC2b is already open due to the '1' on IC2b/4 the internal 1MHz signal from IC1 can pass to the output at pin 10 on the p.c.b.

5.20 The external 1MHz reference is applied via the rear panel IN socket to the shaper Q1 and pulse amplifier Q4. With switch SW1 at EXT, Q6 is turned on by +12V, the resulting logic '1' at IC2a/3 opens the gate IC2d. Since IC2c/9 is also at '1' the external signol can pass through IC2c to the output. At the same time IC2b remains closed due to the logic '0' from Q6 collector, thus inhibiting the 1MHz internal signal from IC1. The gating sequence just described can also be achieved under remote program control (para 5.17).

5.21 The output from the decade divider IC1 is also taken to the base Q2, in which the collector circuit, formed by the primary of T1 with C5, produces a sinewave of 1MHz available for external use from the OUT socket on the rear panel The optimum waveform shape will result from a 1:1 mark-space ratio of the square wave leaving the decade divider IC1.

5.22 The potential divider R31/R32 and the two transistors Q7 and Q8 with associated circuitry provide a constant +5 volts from the +12V source, thus ensuring operation during Standby.

TIMEBASE DIVIDER ASSEMBLY 19-0352 Fig. 4.6

5.23 This is a standard assembly and some of the components are not used by the 9024 but their logic output levels must be such that they prime the gates which are required. Thus in the diagram shown in Fig. 4.6 unused components appear in dashed outline; but pin 17 is taken to 0V, which results in '1' level outputs from the three unwanted gates IC1d, IC6a and IC6b.

5.24 Paragraph 5.10 describes how the Y output from the Function switch determines whether the instrument is set for a frequency or period measurement. For a frequency measurement the Y level is '0', which applied to pin 7 of the Time Base Divider Assembly, will inhibit the gate IC5a which puts a logic '1' on pin 13 of IC5b: pins 9 and 10 of this gate are already at a '1' level from the unused gates IC6a and IC6b. The gate IC6c is opened by the logic '1' from the unused gate IC1d and the $\bar{Y} = 1$ from the collector of Q1. The 1MHz output from the oscillator follows a path via pins 17 and 14 of the Amplifier Gating Assembly 19-0379, and enters the Time Base Divider Assembly 19-0352 on pin 3. The decade elements IC7 and IC8 divide the frequency to 10kHz which then passes through the now open gates IC6c and IC5b to enter the time base divider chain formed by IC's 9 to 13.

5.25 When the Function switch is set to one of the four Period settings its Y output becomes a '1' level and applied to pin 4 of IC5a, in conjunction with the '1' already on pin 2, will open this gate. The $\bar{Y} = 0$ from Q1 will inhibit IC6c blocking the 10kHz output from IC8, and the '1' level output from IC6c will open IC5b. Signals leaving the Amplifier Gating Assembly (19-0379) by pin 15 (see paragraph 5.12) enter the Time Base assembly by pin 8 and pass through gates IC5a and IC5b into the time base divider chain.

5.26 Selection of the required output from the time base divider chain is achieved by a three-line binary code set up by the Function switch and identified as the x,y,z levels. The codes for all eight ranges of the instrument are given in Table 3 below:-

TABLE 3

Function	Time Base Output	Code x	y	z
Frequency Measurement	10s	0	1	1
Frequency Measurement	1s	1	0	1
Frequency Measurement	0.1s	0	0	1
Frequency Measurement	0.01s	1	1	0
Periods Averaged	1000	0	0	1
Periods Averaged	100	1	1	0
Periods Averaged	10	0	1	0
Periods Averaged	1	1	0	0

For example, assume that the Function switch has been set to a gate time af 0.01 seconds or to 100 periods In either of these positions the output from the time base divider chain is from the same point, pin 11 of IC10, therefore the same x, y, z code, 1, 1, 0, appears for each in Table 3 above.

5.27 With cantocts 19, 20 and 18 coded 1, 1, 0 and the inversians af 0, 0, 1 from the three gotes af IC1 which are in use, if the circuit is traced aut it will be seen that anly two gates remain apen, IC3a ond IC4. Thus, anly the output from IC10 is provided with a path to pin 9 for application to the Cantrol Circuit.

THE CONTROL CIRCUIT ASSEMBLY 19-0356

Fig. 4.8

5.28 Thraughaut the following explanation reference should be made to Fig. 4.8 at the rear af the book, certain areas af which, not applicable to the 9024, appear in dashed outline anly.

5.29 The main gate control bistoble farmed by Q3 and Q4 is a high speed circuit similar to that used in the High Speed Decade (Fig. 4.16) and is designed to ensure a fast, clean cantrol of the gating period. When the gate is clased Q4 is in the "an" canditian. An edge from the time base divider, via pin 3, will cause the bistoble to change state, thus turning Q4 off. The high level at the collector af Q4 turns on Q2 and the '0' level at the collector of Q2 is buffered by Q18 which shifts the level and improves the line driving.

5.30 The next signal from the time base divider which marks the end of the gating period will toggle the bistoble again, turning on Q4 and thereby clasing the main gate. This gate caincides with Q3 gaing "aff" to praduce a positive-gaing edge at its callector which will toggle IC1a to praduce outputs of Q = 1, $\bar{Q}$ = 0. The Q autput will turn on Q6 which switches aff Q5 to clamp the main gate cantral bistable in the 'gate clased' state.

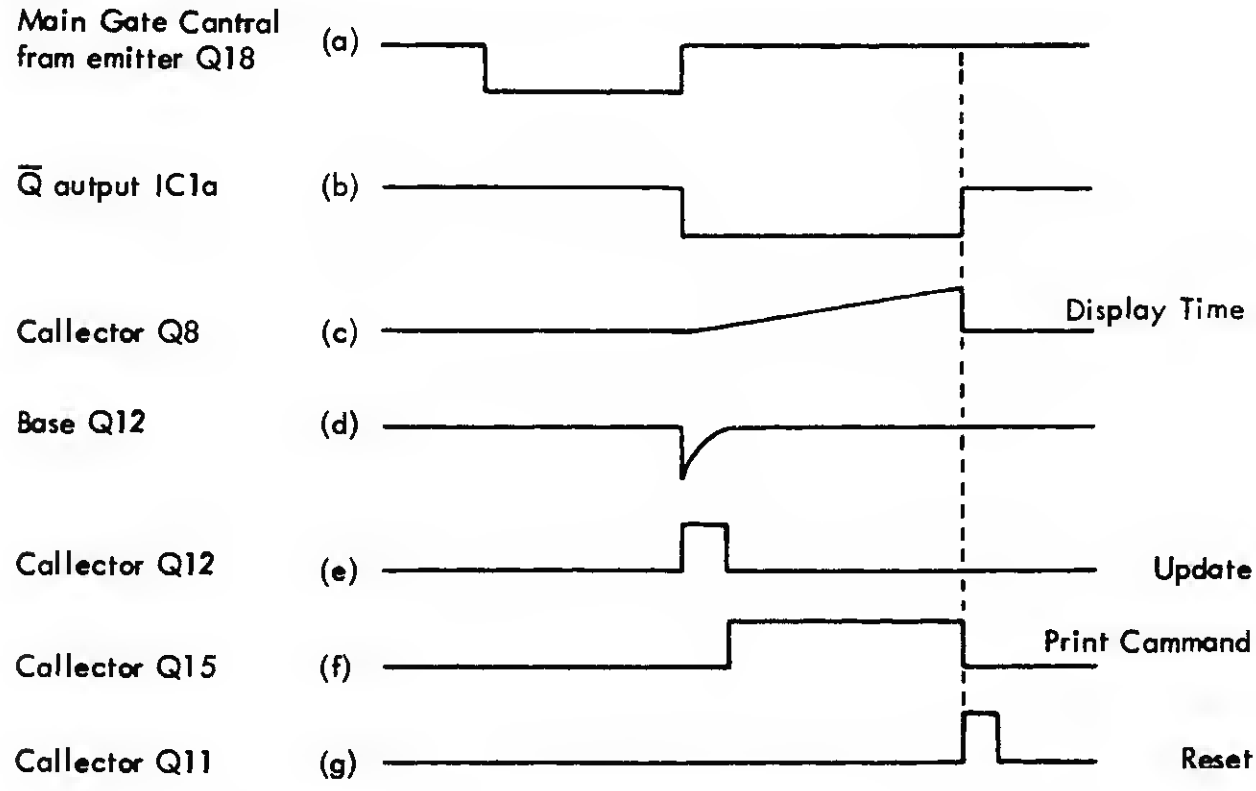


Fig. 2.4. - Cantral Circuit Waveforms

5.31 The $\bar{Q}$ output of IC1a now at '0' will turn off Q8 which permits the Sample Rate Generatar to commence charging (waveform (c) in Fig. 2.4). At the same time the negative-going edge from $\bar{Q}$ is differentiated to switch off Q12 mamentarily and produce the 'update' pulse at Q12 collector; this pulse is fed via pin 17 to the latch input on IC2 of each Readout board. During the high level period of the update pulse, current will flaw through D8 into the base of Q15 keeping this transistor "on"; but when the update pulse reverts to '0' the base of Q15 is maintained at a '0' level by the $\bar{Q}$ output of IC1a. Q15 will turn off and the positive edge at its collectar indicates the start of the 'print-out' period (waveform (f) in Fig. 2.4).

5.32 The charging rate of the time display generator which can be varied from 250 milliseconds to 10 secands, approximately, is determined by the setting of the SAMPLE RATE control on the front panel. Dependent on the setting of the SAMPLE RATE control the charge on C6 will eventually be large enough to cause Q9 and Q10 to conduct, and when they da so C6 discharges very rapidly and during the discharge time Q11 is turned "off" ta produce the reset pulse at its collector.

5.33 The positive-going edge of the reset pulse is inverted by Q7 which immediately clears the bistable IC1a sending its output to $Q = 0$, $\bar{Q} = 1$. Prior to this actian, Q6 was being held on by the high level Q output of IC1a; now, with this IC cleared, Q6 is still held on by the high level of the reset pulse through D16. This maintains the clamp on the gate control bistoble until the reset action throughout the instrument has been completed. The $\bar{Q}$ output of IC1a now at a '1' level turns on Q8 and Q15; this causes Q8 to complete the discharge of C6 and thereby terminates the reset pulse, and Q15 terminates the print command pulse.

External Hold

5.34 If, after the print command output has been initiated when the collector of Q15 goes high, the external equipment deems it necessary to impose a 'hold' condition on the sample rate, it will do sa by sending a logic '1' into the instrument which, via pin 14, will turn on Q19 and thus prevent C6 from charging.

Hald and Single Shot

5.35 To hold a given display for an indefinite time the three-position taggle switch an the front panel will be moved to the 'up' position marked HOLD. This will result in Q17 being turned on sending its collectar "low"; an output which is connected ta the D pin of IC1b. This IC is continuously triggered at intervals of 100 microseconds by the 10 kHz clock signal entering on pin 8 and, with its data input now at '0', its $\bar{Q}$ output becomes a '1' and is applied to the bases of Q6, Q8, Q14 and Q15.

5.36 It has already been explained that a '1' on the base of Q6 locks the main gate control bistable, but if the hold has been applied during a gating period the narmal events on the gate closing and the resultant triggering of IC1a must be suppressed. Therefore the '1' level at the base of Q8 prevents the sample rate generator from charging,

and Q15 will nat produce a 'print-out' command. The new transistor in the sequence is Q14; now turned on it produces a clamp across Q12 and Q13 preventing an update pulse from being generated.

5.37 Returning the HOLD/RESET switch to the centre position turns off Q17 and the next 100 microsecond clock signal, when triggering IC1b, will send the $\bar{Q}$ autput of this IC to '0' removing the conditions imposed in the previous paragraph. In additian the negative-going edge is differentiated by C9 to produce a reset pulse and by C10 to produce an update pulse, in this arder, to pravide a display af zero. The purpase af the monostable Q16 is ta eliminate "cantact baunce" effect when aperating the Hold/Reset switch

5.38 If the SAMPLE RATE control knob is turned fully anti-clockwise until its switch contocts open, it will not be possible for the Sample Rate generator to charge. Under these conditions single shot readings may be token by depressing and releasing the HOLD/RESET switch. Circuit action is the same as described in paragraphs 5-36 and 5-37.

READOUT AND DISPLAY - 19-0460 and 19-0450

5.39 The readout facility is provided by seven latched b.c.d. decade caunters, each af which drives a numerical indicator tube. This arrangement enables a maximum of seven significant figures to be displayed in the stondard version af the instrument. At customer's option an additional Decade Assembly can be fitted to pravide an eight digit readout.

5.40 The indicator tube displaying the least significant figure is driven by a High Speed Decade Assembly 19-0460. The B.C.D. decade counter on this board consists of four separate bistobles, the first of which is a conventional circuit including tronsistors Q14 and Q15. The remaining three are 'D' Type integrated circuit packages (IC3a, IC4a and IC4b). The discrete component values have been chosen to give the counter the very fast switching that is required af the first decade in the counting circuit. The remaining indicator tubes are driven by stondard Readout Assembly boards, (19-0450), each af which employs a single B.C.D. Decade Caunter integrated circuit pockage.

5.41 The Interconnection diagram (Fig. 4.23) shows how the High Speed Decade and the Readout Assemblies are connected in series to provide the counting stoge of the instrument. This operates in the conventionol way, i.e. as each decade completes a count af ten it resets itself to 'zero' and carries '1' to the next decade.

High Speed Decade Assembly 19-0460 Fig. 4.16

5.42 The output fram the Main Gate via pin 10 an the Amplifier Gating Assembly 19-0379 is fed via pin 1 on 19-0460 to the input of the discrete component bistable, Q14 and Q15. This bistable forms the first stage of the 'Divide by Ten' counter (Q14-Q15, IC3a, IC4a and IC4b) and is capable of operating at speeds in excess af 60 MHz.

5.43 Initially, the bistoble Q14-Q15 is in the 'Reset' state, i.e. with Q14 turned an and Q15 turned off. The first negative edge is differentiated by C3/R20 and fed

ta the base of Q14. As o result Q14 turns off and its collector, the Q output af the bistable, gaes ta logic '1'. This is then fed via the emitter follawer Q13, as the digit '1' output of the caunter ta the decading network for the indicator tube. This is morked A^1 an the circuit.

5.44 The $\bar{Q}$ autput af the bistable, Q14-Q15, is fed via the emitter follawer Q16 to the 'Clock' input (pin 11) of IC3, the second stage af the counter. The logic '1' an the 'D' input (pin 12) is transferred to Q autput (pin 9) by the first positive edge fram the emitter af Q16 (i.e. the $\bar{Q}$ autput af the first bistable). This accurs when the second negative edge is fed fram the Main Gate to the input of the first bistable, which via the differentiating netwark C5 and R26 turns off Q15.

TABLE 4

High Speed Decade Board: Sequence of Operatians

'CLOCK' input to IC3a & IC4b	Logic Descriptian	Divide by 10 Caunter O/Ps 1 (A)	2 (B)	4 (C)	8 (D)
1st	Q output af IC3a gaes ta lagic '1'; Q autput of IC4b remains at logic '0' because the 'D' input is held at logic '0'.	0	1	0	0
2nd	Q output of IC3o goes to logic '0'. $\bar{Q}$ autput of IC3a going to logic '1' 'clocks' IC4a; the Q output of IC4a goes to logic '1'. The Q out put of IC4b remains at logic '0'.	0	0	1	0
3rd	Q autput af IC3a gaes to logic 1. Transit delays prevent the emitter af Q20 going to logic '1' in time far that level to be transferred ta the Q output af IC4b.	0	1	1	0
4th	Q output of IC4b gaes to logic '1'. Q outputs of both IC3a and IC4a go to lagic '0'. This returns the emitter of Q20 to logic '0'. The Q output of IC4b opplies a lagic '0' via Q18 anto the 'CLEAR' input of IC3a.	0	0	0	1
5th	Q output of IC3o remains ot logic '0' because 'CLEAR' input at lagic '0' over-rides the 'D' input. Q output of IC4b returns to logic '0'.	0	0	0	0

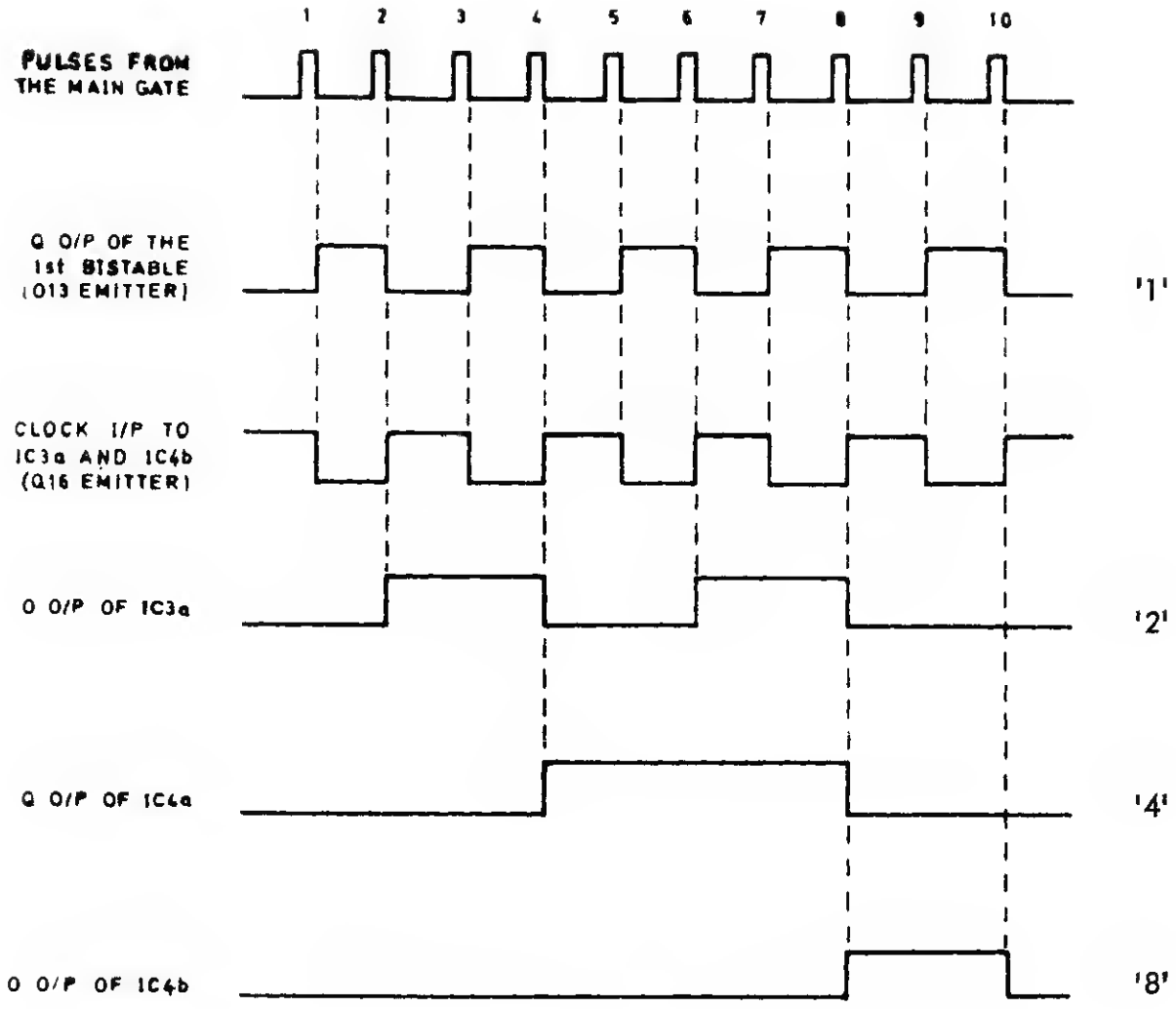


Fig. 2.5 Timing Diagram: High Speed Decade 19-0460

5.45 It can be seen from Fig. 4.19 that the $\bar{Q}$ output is also fed to the 'Clock' input (pin 11) of IC4b. The Q output of IC4b remains at logic '0' because the 'D' input (pin 12) of IC4b is held at logic 0 by the emitter of Q20.

5.46 The Q output of IC3 is fed as the 'digit 2' output of the counter to the decoding network for the indicator tube. Table 4 in conjunction with the timing diagram in Fig. 2.5 explains how IC3a, IC4a and IC4b operate to provide the '2', '4' and '8' outputs from the counter.

5.47 The '8', '4', '2', '1' outputs from the divide-by-ten section are fed to the Quad-Latch element IC2 which stores the information until it is released by an update pulse from pin 17 of the Control Circuit Assembly 19-0356. On release from IC2 the information is decoded by the gates IC1a, b, c and d and by transistor Q1. The BCD information for external readout is taken via R4, R13, R15 and R17. The decoding method is identical to that in the Standard Readout Assembly 19-0450 which is summarised in Table 5. In comparing the two circuits note that there are minor differences in component referencing, for example Transistor Q1 on the High Speed Decade is referenced Q2 on the Standard Readout.

5.48 The B.C.D. Decade Counter IC3 counts the number transitions between logic '1' and logic '0' which occur at its input on pin 14. IC3 counts a total of 10 negative edges before resetting itself to zero and carrying '1' to the next decade, i.e. the next Readout Assembly.

5.49 As the count progresses the 8421 outputs of IC3 are fed into IC2 where the information is held during the counting period. On receipt of the latch pulse at pin 6 of the board the stored information is released to turn on the appropriate transistor which illuminates the required digit in the indicator tube. For a transistor (Q3 to Q12) to conduct, its base must become more positive than its emitter. Table 5 on the next page shows the sequence of operations for obtaining the required conditions for each transistor.

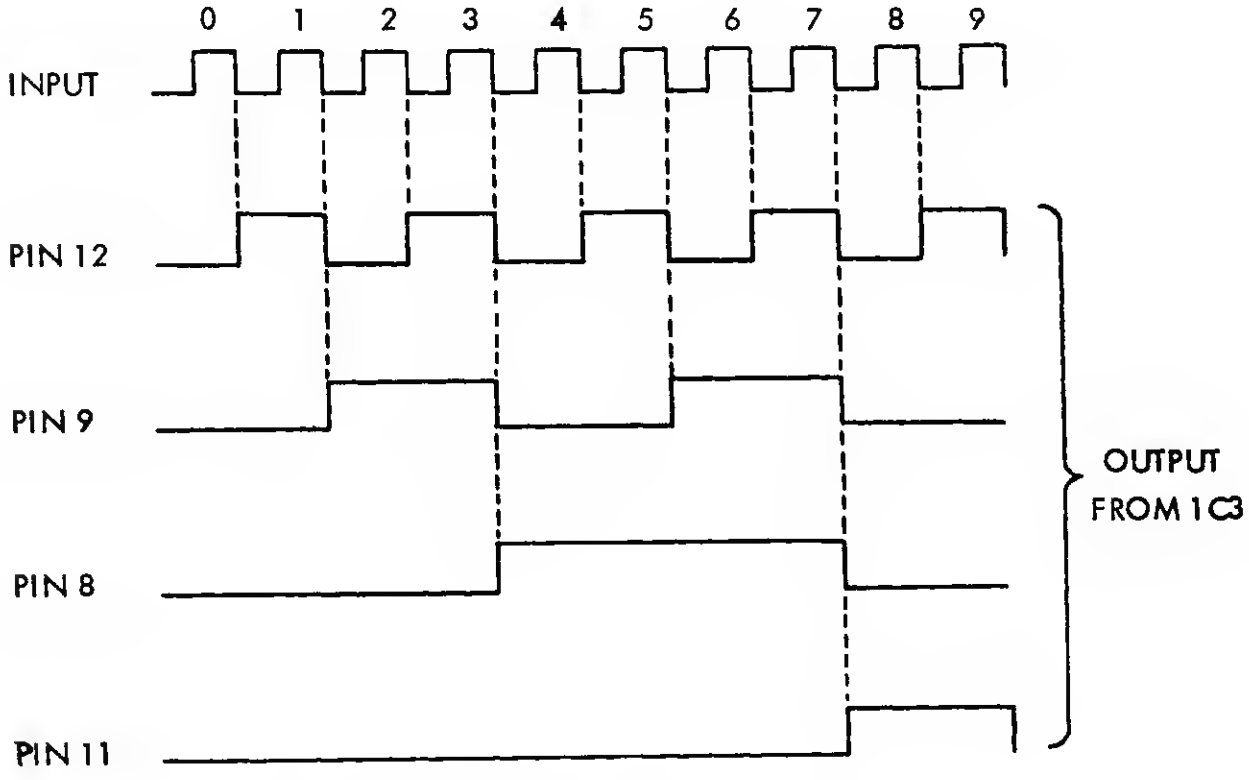


Fig. 2.6 Timing Diagram: Standard Readout Decade

TABLE 5

Stondord Reodout Boord : Sequence of Operations

DIGIT DISPLAYED	'8'	'4'	'2'	'1'	TRANSISTOR	BASE	EMITTER
0	0	0	0	0	Q3	Held ot Vcc. Q2 turned off by logic '0' on its bose	Goes to logic '0' by the '1' output from IC3
1	0	0	0	1	Q4	As above	Goes to logic '0' by output IC1d
2	0	0	1	0	Q5	Goes to logic '1' by output of IC1d ($\bar{A}$)	Goes to logic '0' by output of IC1o
3	0	0	1	1	Q6	Goes to logic '1' by '1' output of IC3(A)	As above
4	0	1	0	0	Q7	Goes to logic '1' by output of IC1d($\bar{A}$)	Goes to logic '0' by output of IC1b
5	0	1	0	1	Q8	Goes to logic '1' by '1' output of IC3(A)	As above
6	0	1	1	0	Q9	Goes to logic '1' by output IC1d($\bar{A}$)	Goes to logic '0' by output of IC1c
7	0	1	1	1	Q10	Goes to logic '1' by '1' output of IC3(A)	As above
8	1	0	0	0	Q11	Goes to logic '1' by the '8' output of IC3	Goes to logic '0' by the '1' output of IC3
9	1	0	0	1	Q12	As above	Goes to logic '0' by the out-put of IC1d

5.50 The standard readout (19-0450) decades are fitted with decimal point indication in the form of a lamp mounted beside each numerical indicator tube, but only in four of the assemblies is this lamp in circuit. The decimal points are illuminated by switching on an associated series transistor (Q1, Q2, Q3 or Q4) mounted on the Motherboard Assembly (see Fig. 4.23). The appropriate transistor being switched on by a '1' level applied to the base by a contact closure on the Function switch.

Latched Display and Transfer Pulse

5.51 In both the High Speed Decade and the Standard Readout Board, the integrated circuit IC2 provides for a latched display. The transfer pulse which releases the stored information is applied from the Control Circuit Assembly to pin 6 of each Readout Assembly. A slight delay is applied to this transfer pulse by transistor Q7 and its associated time constant network, which is mounted on the Motherboard. (Fig. 4.23). This delay is to ensure, that when operating to maximum count capacity, the transfer pulse to the overspill bistable IC2b is delayed to compensate for transit time through the preceding decode chain.

Overflow Lamp

5.52 The overflow lamp is illuminated by an output (overspill) pulse from the final counting decade. The circuit for translating this overspill pulse into lamp illumination is provided by IC2a, IC2b and transistors Q5 and Q6 on the Motherboard. The appropriate link LK5 or LK6 (Fig. 4.23) is connected according to whether a 7-digit or 8-digit display is fitted.

5.53 The reset pulse from the Control Circuit assembly is inverted by Q5 and applied to the integrated circuit IC2a, setting this JK bistable to $Q = 0$ and $\bar{Q} = 1$. The first pulse out from the final decade is applied to the Trigger input of IC2a and the bistable will toggle to produce outputs of $Q = 1$, $\bar{Q} = 0$. This latter level fed back to the J and K inputs will prevent the bistable from responding to any further pulses from the final decade. The second JK bistable, IC2b, acts as a store responding only to the 'update' commands from the Control Circuit. On receipt of such a signal the level at the J input is transferred to the Q output; if this level is a '1' the transistor Q6 will turn on and illuminate the overflow lamp LP1.

POWER SUPPLY ASSEMBLY 11-0565 Fig. 4.3

5.54 This is o self contoined unit incorporoting oll the components ossociated with supply af d.c. power rails to the 9024. It comprises the following items:-

(a) Mains input socket.

(b) Mains Filter Assembly 19-0475.

(c) Moins Voltage Selector.

(d) Mains Transformer T1.

(e) Power Stabiliser Assembly 19-0433 (P.C.B.).

(f) Smoothing Capacitors C1, C3, C6, C10, C13.

(g) Heot Sink bracket mounting the four 'series regulotor' transistors Q2, Q6, Q9, Q12 and the zener diades D5 and D8. (See Fig. 2.7)

5.55 The assembly provides the following power rails, full wave rectified, smoothed ond fused os indicoted.

Power Supply Rails

Roil	Supply for:	Fuse Rating
+220V d.c.	Indicator Tubes	FS1 - 60 mA
+12V d.c.	Discrete Circuitry	FS2 - 750 mA
+5V d.c.	TTL Pockages	FS3 - 1.5A
-5.4V d.c.	ECL Pockages	FS4 - 500mA
-12V d.c.	Discrete Circuitry	FS5 - 500mA

5.56 All except the +220V d.c. rail ore stabilised against variatians in load current and fluctuotions in mains voltage (by conventianal series regulotion techniques). It is not necessary to stabilise the 220V rail becouse voriations in the voltage due to mains fluctuatian will nat prevent the indicatar tubes, which it supplies, from aperating carrectly.

Pawer Stabiliser Assembly 19-0433

5.57 This is a printed circuit board assembly cantaining a full wave rectifier bridge D1, D2, D4, D6 and D9 (one far each pawer rail) a bleeder resistar R1 far remaving residual charge an the +220V d.c. rail smaathing capacitar C1, and stabilisatian circuitry far the +12V, +5V, -5.4V and -12V rails. It does not cantain the series regulator transistars Q2, Q6, Q9 and Q10; these are maunted an a separate 'Heat Sink' bracket. The bracket alsa mounts the zener diades D5 and D6 which provide averlaad protectian far the TTL and ECL packages, supplied by the +5V d.c. ond -5.4V rails respectively.

5.58 The 220 volt autput is unregulated, but the +12V, -12V, -5.4V and +5V autputs each have a conventianal regulating system which is the same in principle for each rail although the individual circuits differ slightly. Stobilizatian af each autput is achieved by an 'error detectian' circuit which, responds to a change in valtage level at the autput. Each stabilized autput can be pre-set to the required level by the appropriate patentiameter R8, R16, R22 and R30. It is importont that this adjustment is made with the mains supply valtage at the carrect level.

5.59 It shauld be noted thot the stabilizing circuits are ta some extend inter-dependant. Far example the +12V and +5V circuits ase a common reference diade D3 and the cantral circuit in the +5V sectian is connected to +12V via a contact on the Pawer switch; alsa the +12V control relies on a connection via R3 and R2 ta the +220V rail. Similarly the -12V regulator relies an a +5V supply far its operotion. These points could be significant in fault lacatian.

POWER SWITCHING

5.60 The a.c. mains supply is not switched therefare dangerous a.c. voltages ore present in the instrument so lang as it is cannected ta an a.c. supply. The Pawer switch aperates in the +220V and +12V autputs. When the power switch is set ta ON +12volts is supplied ta the +5V stobilizer, thus turning an the +5V autput which in turn completes the -12V aantral circuit. The Frequency Standard aven is supplied with +12V fram pin 25 af the p.c.b. irrespective af the setting af the pawer switch, thus praviding immediate accuracy after a periad an Standby.

CHAPTER 6

MAINTENANCE

TEST EQUIPMENT REQUIRED

6.1	(a)	Multimeter:	20 kΩ/volt D.C. valtage range 0-250 Example: AVO 8.
	(b)	Oscilloscope:	Bandwidth: D.C. to 20 MHz Sensitivity: 50 mV/cm Example: Tektronix 543, which alsa pravides suitable calibrated output.
	(c)	Passive (X10) Probe:	Tektronix P6006, ar similar.
	(d)	Frequency Standard:	1MHz, Accurate to 1 part in 10^8, 1V r.m.s. (nominal).
	(e)	H.F. Signal Generator:	Upper Frequency limit must be not less than 600 MHz. 8mV ta 2V r.m.s.
	(f)	L.F. Signal Generator:	To cover frequencies dawn to 10 Hz.
	(g)	Variable Auta-Transformer:	Far power supply check. 0-260 V a.c. Example: Variac.
	(h)	Electronic Valtmeter:	Ta be used if calibrated signal generatar not available. Example: Racal-Airmec 301A.
	(i)	Coaxial Lead:	50 ohm. BNC to BNC connectors, apprax. 1 metre (3 ft) long.
	(j)	BNC 'T' piece and 50 Ω terminating pad:	

USE OF TEST EQUIPMENT

6.2 The test equipment listed above will be connected directly to the instrument under test and used according to the manufacturers instructians. All signal generator inputs ta the 'B' Channel must be made via a 50 ohm terminating pad except when the input is made via the passive probe unit.

REMOVAL OF CASE

6.3 Remove the case of the instrument as described on page 2-1.

WARNING: A.C. MAINS SUPPLY VOLTAGE AND 220 V D.C. ARE EXPOSED WHEN THE INSTRUMENT IS REMOVED FROM ITS CASE.

FUSE CHECK

6.4 Check that fuses are of correct value and securely fitted. See Table 2 on page 2-3 and chassis photograph Fig. 2.7 at the end of this chapter.

NOTE: Care should be taken at all times to avoid the risk of electrical shock. Remember that mains power is connected to the oscillator even when the POWER switch is at STANDBY; to remove all dangerous voltages the power lead must be disconnected from the supply outlet.

GENERAL PERFORMANCE CHECK

6.5 Before commencing any setting-up procedures ensure that the instrument is serviceable and that the power supply voltages are correct.

Self Check

6.6 Carry out the Self Check procedure as given on page 2-2.

POWER SUPPLY CHECK

6.7 Equipment Required:- (a) Multimeter
(b) Variac Unit

Procedure

(1) Connect the mains supply and set the POWER switch to STANDBY. Note that the 'Standby' lamp illuminates.

(2) Check that the mains supply voltage is at a satisfactory level. Set the POWER switch to ON.

(3) Set the Multimeter to the D.C. voltage range (250V or higher) and connect the negative lead to chassis (0V) or to pin 27 on the power supply board.

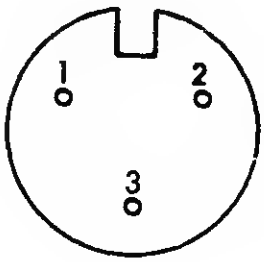
(4) Connect the positive leod to the following test points on the power supply board 19-0433 ond check the voltages. If necessary adjust R8, R16, R22 and R30 as indicated below:-

Test Paint	Required Valtage	Remarks
24	+220V ± 10V	Na adjustment
25	+12V ± 0.1V	Adjust R8
28	+5V ± 0.1V	Adjust R16
29	-5.4V ± 0.1V	Adjust R22
30	-12V ± 0.1V	Adjust R30

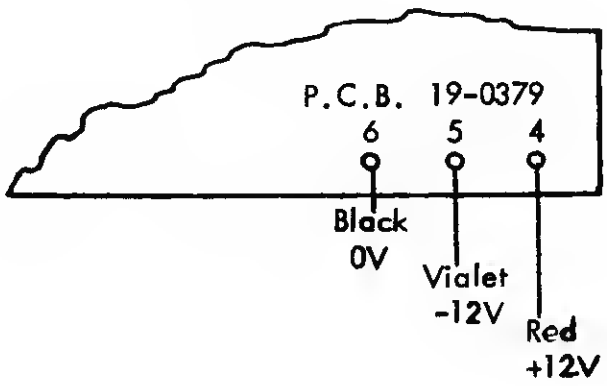
(5) If a suitable unit, such as a Variac, is available, this should be connected in the a.c. mains supply and the mains voltage varied by plus and minus 6%. At the some time check that the +12V, -12V, -5.4V and +5V readings do not vary be mare than ±0.1V.

(6) Probe Power Supply

Check the Probe power supply at the Probe socket on the front ponel. (See pin diagrom belaw). The 0V cannectian of the multimeter lead may canveniently be mode ta pin 6 af the A.G.A. baord, 19-0379 an which the Prabe power filtering companents are mounted. (see fig. 2.7). Take care to avaid shart circuits if testing at the Probe Pawer socket.



Pin 1 = 0V
Pin 2 = +12V±0.1V
Pin 3 = -12V±0.1V



PERFORMANCE TESTS AND SETTING-UP PROCEDURES

NOTE: When feeding o signol generator signol into the Chonnel 'B' Input socket o BNC 'T' piece with 50 ohm load must be used.

Setting-Up Internol Frequency Stondords

6.8 NOTE: Ensure thot the link on the oscillotor p.c.b. assembly is set for ÷ 10 (10MHz oscillator) or ÷ 5 (5MHz oscillator) os shown in Fig.4.2.

Equipment Required:- Oscilloscope
1MHz external frequency stondord, with occurocy better thon one part in 10^8.

Procedure

(1) Check thot the 9024 has been on STANDBY for not less than holf on hour. Set the POWER switch to ON.

(2) Set the INT/EXT switch on the rear ponel to INT.

(3) Connect the 1MHz external standord to the 'External Trigger' input of the oscilloscope.

(4) Connect the oscilloscope lead to the inner pin of the '1MHz OUTPUT' socket on the rear panel, (Screen to chassis).

(5) In the Oscillator Type 9400 adjust the mechanicol tuning via the operture in the oscillotor cose to obtain a stationory troce. Observe the oscilloscope display ond check that in a period of 1 minute not more thon one cycle of displayed woveform moves past a fixed point on the oscilloscope face.

(6) If the instrument is fitted with Oscillator Type 842 or 9420 the procedure is the some os (5) obove, except that tuning is by meons of the "coarse" and "fine" tuning potentiometers accessible via apertures in the reor ponel of the instrument.

1MHz Output Amplitude Check

6.9 (1) Terminote the reor panel Terminal 1MHz OUTPUT with o BNC 50 ohm pad.

(2) With the INT/EXT switch set to INT connect the oscilloscope to the 1MHz OUTPUT socket on the rear ponel ond check thot on opproximotely sinusoidol woveform is displayed, with on amplitude of not less thon 1 volt peak-to-peok. If necessary odjust the core of tronsformer T1 on the oscillotor p.c.b. (fig.4.12) to obtain the maximum output level.

(3) Disconnect the test equipment.

External Frequency Standard Input

6.10 (1) Set the Sensitivity switch to the CHECK pasitian and the FUNCTION switch ta the '1 sec kHz' pasition.

(2) Set the SAMPLE RATE cantrol clackwise.

(3) Cannect the 1MHz external standard ot 1 valt r.m.s. ta the rear panel socket EXT. FREQUENCY INPUT.

(4) Set the rear panel INT/EXT switch to EXT.

(5) Check thot the 9024 displays a reading af 1000.000 ±1 count.

Pre-Amplifier Assembly (11-0339) Fig. 4.1, 4.4

6.11 The pre-amplifier assembly comprises the switch together with an attenuatar baard (19-0235) and o pre-amplifier board (19-0236) which are cantained in the metal case immediately behind the Channel B Sensitivity cantrol.

Equipment Required

(a) Oscilloscape: Tektronix 543 recommended.

(b) Passive (x10) Prabe: Tektronix 6006 ar similar.

(c) A source af 1kHz calibroted square-wove voltages at 0.1V, 1V and 10V peak-to-peak is required. The calibrated autput from the Tektronix 543 is very suitable. Alternatively a square-wave generator with a rise time af appraximately one micrasecand should be used.

(d) H.F. Signal Generatar.

(e) BNC 'T' connectar with 50 ahm laad.

6.12 Setting the Attenuator

(1) Remave the caver from the Pre-Amplifier assembly.

(2) Set the SENSITIVITY switch to the .01 positian and the HOLD/RESET switch to HOLD. Switch an the power.

(3) Cannect the passive probe ta the input socket of the 9024.

(4) Set the calibrated square-wave source to give an autput af 1kHz at 0.1 volts peak-ta-peak.

(5) Cannect the tip af the passive probe ta the autput af the square-wave source.

(6) Connect the oscilloscope probe to pin 1 (input) and earth on the pre-amplifier board 19-0236 and check that the amplitude is 10mV peak-to-peak. If necessory adjust the passive prabe to give an optimum square-wave. (19-0236 is the upper of the two boards).

(7) Set the Channel B Sensitivity switch to the 0.1 position.

(8) Set the calibrated square-wave source to 1 volt peak-to-peak.

(9) With the oscilloscope probe connected as in (6) abave, adjust the capacitor C3 on the attenuator board 19-0235 (via the hole in the upper board) to provide an optimum squore-wove on the oscilloscope display with an amplitude of 10mV peak-to-peak.

(10) Set the Channel B Sensitivity switch to the 1V position and the calibrated square-wave source to 10 valts peak-ta-peak.

(11) Repeat the pracedure given in (9) but adjusting C5 via the appropriate hole in the upper board.

(12) Disconnect the square-wave source and passive probe.

6.13 Pre-Amplifier Frequency Response

(1) Set the Sensitivity switch to the .01 position and the HOLD/RESET switch to HOLD. Switch on the power.

(2) Connect the H.F. signal generator to the input socket of the 9024 via the 'T' piece with 50 ohm load, and apply a signal of 10mV r.m.s. at a frequency of 10 MHz.

(3) With on oscilloscope, or electronic or digital voltmeter, check the r.m.s. level at the rear of the Channel B input socket on the 9024 and also the autput level from the pre-amplifier. (A convenient point is between pin 7 and chassis on the A.G.A. 19-0379). Calculate the amplifier gain which should be 8 dB ±3 dB.

(4) Repeat (3) but at a frequency of 50 MHz.

Attenuator 19-0620 Fig. 4.17

6.14 Equipment Required:- (a) Signal Generator. (500 MHz).

(b) 'T' piece and 50Ω load.

Procedure

(1) Apply 480 MHz at 10mV r.m.s. from the signal generator via the 'T' piece and 50Ω load to Chonnel A input socket.

(2) Set Chonnel A Sensitivity switch to 0.01 V ond switch the power on.

(3) Reduce the input from the signal generator until the disploy ceoses to operate, then corefully increose the input until the disploy just operates (Threshold). Note the input level setting on the signol generator.

(4) Set the Chonnel A Sensitivity switch to 0.1 V ond carefully increose the input until the disploy just operates. Note the input level setting on the signol generator.

(5) The input voltage level required to operate the disploy in (4) should be 20 dB ±3 dB higher than thot required to operate the display in (3).

Amplifier Divider Assembly 19-0630 Fig. 4.20

6.15 The amplifier divider assembly comprises the input omplifier a shaper circuit ond a divide by ten integrated circuit.

Equipment Required

(a) H.F. signol generator with frequency range up to 600 MHz.

(b) Electronic Voltmeter (for gain check).

(c) Oscilloscope (for shoper odjustment).

6.16 Sensitivity (Shoper) Adjustment

(1) From the signol generotor opply 10 MHz ot 10 mV r.m.s. to Input Socket A on the instrument.

(2) Set the Channel A Sensitivity switch to 0.01V.

(3) Connect the high impedance probe of on oscilloscope to the junction of C18/R31.

(4) Adjust the potentiometer R24 to the centre of the movement which produces o 1:1 mork-space ratio on the rectongulor waveform. The omplitude should be opproximately 500 mV peak-to-peok.

6.17 Wideband Amplifier Check

NOTE: For satisfoctory odjustment of the bandwidth, using trimmers C3 ond C8, the use of o sweep sconner such as o "Polyskonner" is essentiol (See para. 6.28). Using bosic servicing equipment the omplifier goin con be checked only ot the lower end of the bond. If o loss of sensitivity ot the higher frequencies is suspected, the board should be returned to Rocol Instruments Limited, or on opproved Agent.

Procedure

(1) Apply o signol of 10 MHz ot 10 mV r.m.s. from the signal generotor to Input Socket A.

(2) Set the Sensitivity switch to 0.01V.

(3) Connect the electronic voltmeter to base of Q6 (junction of R26/C16) vio o 0.1 µF copocitor in series with o 100 ohm resistor. All leods ore to be os short os possible.

(4) Check thot the overoll goin is 14 dB ±3 dB.

(5) Repeot the test with on input of 50 MHz.

(6) The obove tests will estoblish the basic serviceobility of the board, for o more odvonced procedure employing o sweep sconner refer to para. 6.28.

Amplifier Gating Assembly 19-0379

6.18 The nominal goin of the widebond omplifier together with the 'B' Channel pre-amplifier 32 dB ±4dB ot 10 MHz rising to 34 dB ±4dB ot 60 MHz. The gain is measured between the front panel input socket ond pin 20 on ossembly 19-0379.

Equipment Required

(o) H.F. signol generotor with frequency ronge up to 60 MHz.

(b) Electronic voltmeter (for goin check).

(c) Oscilloscope (for Shoper check).

6.19 Amplifier Goin Check

(1) Set the signal generator to 10 MHz ond opply o signol of 10 mV r.m.s. vio the 'T' piece ond 50 ohm lood, to the input socket (Channel B) of the 9024

(2) On the board 19-0379 connect the electronic voltmeter between pin 20 (TP1) ond chossis.

(3) Check thot the overall goin between the input socket ond TP1 is 32 dB ±4 dB. If necessary odjust C11 ond C18 to obtain this gain.

(4) Chonge the signol generator frequency to 60 MHz ot 10 mV r.m.s. Repeot the meosurements os in (3) ond check that the gain is 34 dB ±4 dB. Making fine odjustment to C11 ond C18 if required.

(5) Repeot (3) with 10 MHz input ond (4) with 60 MHz input unfll the goin figures ore obtoined without further odjustment of C11 ond C18.

(6) Disconnect the electronic voltmeter.

6.20 1st Shaper Check (Schmitt Trigger Q6 ond Q7)

(1) Connect the signal generator to the Chonnel B input socket vio the BNC 'T' piece with 50 ohm load, and apply o signol of 1kHz ot 10mV.

(2) Set the Chonnel B Sensitivity control to the .01 V position.

(3) Connect the oscilloscope probe to pin 22 (TP2) ond 0V on the A.G.A. board 19-0379.

(4) Observe the square-waveform display and if necessary adjust R25 to obtain a 1:1 mork/spoce ratio with on omplitude of opproximotely 4V peok-to-peak.

(5) Reduce the input level from the signal generator until the Schmitt Trigger just fails to operate. Then re-adjust R25 to restore operation of the Schmitt Trigger.

(6) Corefully repeot operation (5) until the lowest possible input voltoge hos been found at which the Schmitt Trigger will operate, thus ochieving the most sensitive condition.

(7) Disconnect test equipment.

Sensitivity Check

6.21 In the following check the signal generator voltage must be 'calibrated' by an electronic voltmeter to ensure on occurate 10mV input.

Equipment Required:- Signol Generator and 50 ohm pad.
Electronic Voltmeter.
15pF Copacitor.

Procedure

(1) On the 9024 set the Channel B Sensitivity switch to the .01 V position ond the HOLD/RESET switch to HOLD.

(2) Connect the signal generator to the input of on electronic voltmeter with o 15pF copacitor shunting the 50 ohm input of the voltmeter. This simulotes the 9024 input conditians.

(3) Set the signol generator output level to exoctly 10mV on the voltmeter Note the exoct setting of the signal generator control.

(4) Connect the signal generator vio the BNC 'T' piece with 50 ohm loao to the Chonnel B input of the 9024.

(5) Set the signol generator frequency ond the 9024 Function switch to the settings listed in Table 6 overleaf. Check that in eoch instance a stoble ond occurote disploy is obtained.

TABLE 6

'B' Chonnel Sensitivity Check:

Function Switch Gote Time	Input Frequency	Remorks
1.0 sec	10Hz	Sensitivity Switch set to 0.01V
1.0 sec	100Hz	
0.10 sec	1kHz	
0.10 sec	10kHz	
0.01 sec	100kHz	
0.01 sec	1MHz	Input level to be not higher thon 10mV r.m.s.
0.01 sec	10MHz	
0.01 sec	25MHz	
0.01 sec	60MHz	

(6) Tronsfer the signol generotor to the Chonnel 'A' input socket (50 ohm lood not required).

(7) Repeat operotion (5) but in occordonce with the details in Toble 7 below.

TABLE 7

'A' Chonnel Sensitivity Check:

Function and Sensitivity Switch Settings	Input Frequency (MHz)	Input Level
Gate Time 0.01 secs ond Sensitivity Setting 0.01V for oll tests	10 100 200 300 400 500	10mV r.m.s.
	550 600	100mV r.m.s.

Display Timing Check

6.22 Equipment Required: Oscilloscope

Procedure

(1) Set the Channel 'B' Sensitivity switch to CHECK, and the Channel Selector switch to Channel 'B'.

(2) Set the Function switch to Gate Time 0.01 sec. and check that the display reads 0010 000 ± 1 count.

(3) Turn the SAMPLE RATE control to maximum clockwise position and observe the fast sample rate (short display time).

(4) Connect the oscilloscope probe to the collector of transistor Q11 on the control circuit assembly 19-0356 (screen to 0V).

(5) Turn the SAMPLE RATE control anti-clockwise, at the same time observing on the oscilloscope that the period of the reset pulse changes from less thon 250 milliseconds to 10 seconds ± 1 second. Finally turn the control to the SINGLE SHOT (Click) position.

(6) While operating on Single Shot, briefly depress the HOLD/RESET switch to the RESET position and release, noting that this updates the display.

(7) Set the Function switch to Gate Time 10 sec. and note that the Overflow lamp illuminates at the conclusion of the count period.

Data Output Check

6.23 This check applies only to instruments fitted with Option 01 or Option 02.

Equipment Required:

(a) Suitable printer or simulator

(b) Signal generator.

(1) Connect the printer via the 50-way connector on the rear panel designated BCD.

(2) Connect the signal generator to the Channel 'B' input via the 50 ohm 'T' piece. Set the Channel Selector switch to 'B'.

(3) Set the Channel 'B' Sensitivity switch as appropriate and apply a signol generator output to display all digits in turn. Set the Function Switch as required. Observe displayed numbers and decimal points and check that the printout is identical.

(4) Select 10 second gate on the 9024 and check that the Overflow lamp illuminates. Check that remate averflaw indicatian is obtained (if this facility is connected).

Remote Contral Check (Optian 02)

6.24 This infarmatian will be included with the Appendices at the rear of the handbaak when required.

MISCELLANEOUS SERVICING INFORMATION

Lamp Changing

6.25 Ta change the Overflow and Standby indicator lamps unscrew the lens and lift aut the bulb with collet attached. Transfer this collet to the new bulb before fitting.

Tunnel Diode Replacement

6.26 The tunnel diade D2 in the Amplifier Divider Assembly 19-0630 is fitted by a special technique ta ensure optimum perfarmance. If servicing af this campanent becames necessary it is recommended that the wark be carried out by Racal Instruments Service Department.

SUPPLEMENTARY ALIGNMENT PROCEDURE

AMPLIFIER DIVIDER ASSEMBLY: 19-0630

Overall Gain and Respanse Check Using Sweep Scanner

NOTE: It is assumed that the user is fully conversant with the type of sweep scanner to be used and that the Amplifier Divider Board is mounted in a serviceable instrument.

6.27 Equipment Required:

(a) Sweep Scanner such as a Knott "Palyskanner".

(b) Coaxial lead with BNC plug at each end.

(c) Coaxial lead with BNC plug at one end and apen wire at the ather, with 100 ohm resistor and 0.1μF capacitor wired in series.

6.28 Procedure

(1) Allaw the Sweep Scanner to warm up and set the controls for H.F. operation with output attenuation of -25dB and frequency sweep (initially) of 0.5MHz to 50MHz.

(2) Set up the Sweep Scanner to an appropriate input reference for gain measurement.

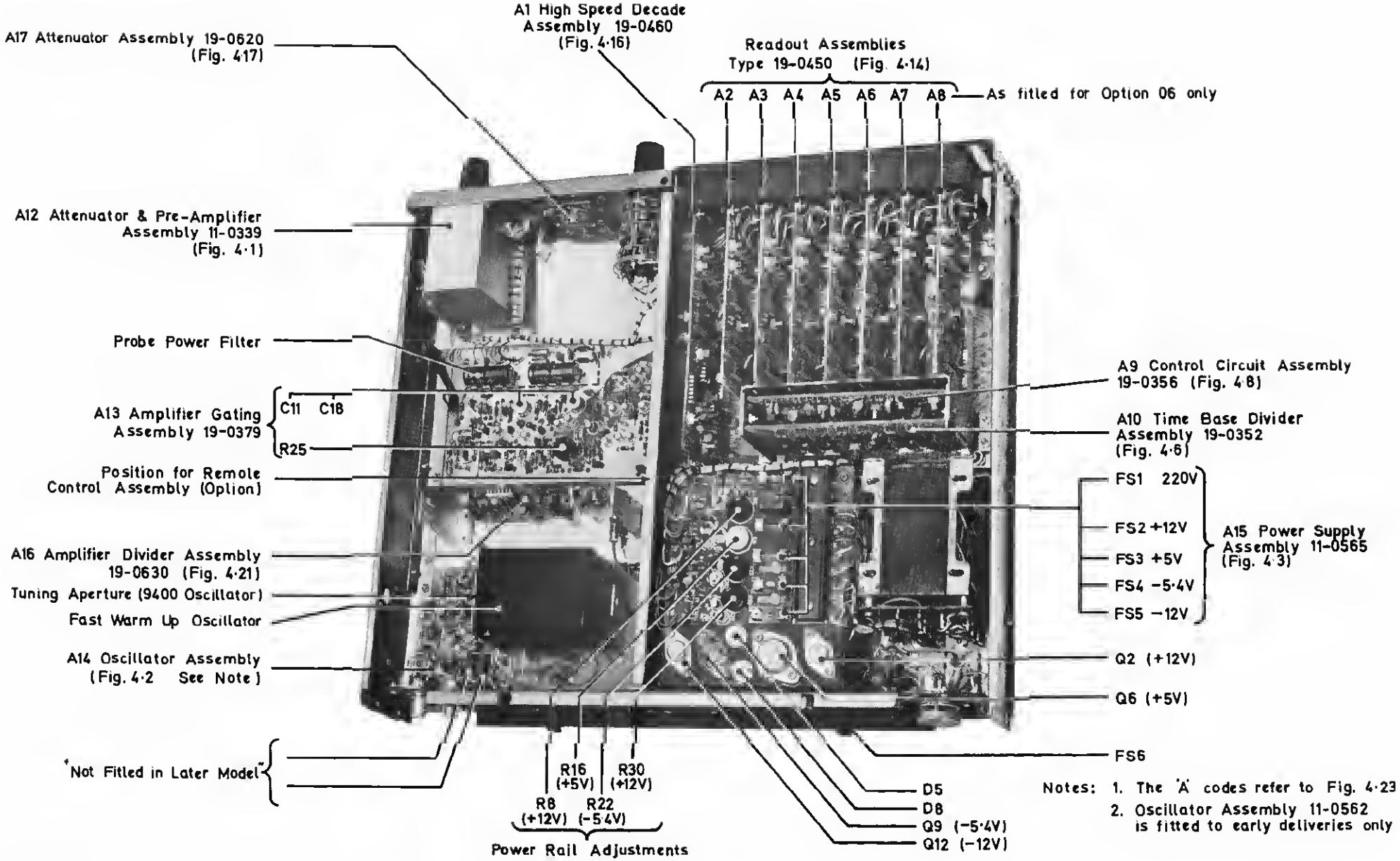
(3) Connect the R.F. OUTPUT socket of the Sweep Scanner to the INPUT socket af the 9024 under test.

(4) On the 9024 set the 'A' Channel SENSITIVITY switch ta the most sensitive setting. (0.01V).

(5) Using the open-ended caaxial lead, with the 100 ohm resistor and 0.1μF capacitor wired in series, connect the Sweep Scanner R.F. Input socket ta the base of transistor Q6 (junction of R26/C16) on the Amplifier Divider Board. The braiding should be lightly soldered to the adjacent OV track during this test.

(6) Switch on the pawer to the 9024 under test and carry out the amplifier frequency response check over the bandwidth 10MHz to 600MHz. If necessary adjust the trimmer capacitors C3 and C8 on the Amplifier Divider Board to achieve maximum bandwidth with flat response.

(7) Check the amplifier gain which should be 14dB ± 4dB from 10 MHz to 400 MHz, falling to 0dB gain at approximately 550MHz.



WOH2078
A B

Service View: Chassis Upperside

Fig. 2·7

PARTS LIST

CONTENTS

Replacement Resistors

The Erie Type 15 composition resistor which has 0.4 inch (10mm) lead spacing may be replaced by the Mullard Type CR16 Carbon Film type. In cases where the printed circuit board has resistor mounting holes with 0.5 inch (12.5mm) spacing, the recammended replacement resistar is the Mullard CR25, (330mW, carbon film type. The Mullard CR25 may also replace those $\frac{1}{4}$ watt 5% metal oxide resistars which have 0.5 inch hole spacing.

Part No.	Description	Rat	Tal %	Value	Component References	Vendor
	PRE-AMPLIFIER ASSEMBLY, 11-0339					
	(also refer to Assemblies 19-0235 and 19-0236)					
	Resistors	watts				
20-0100	Composition	1/10	10	10	R21,R22	Erie 15
20-0560	Composition	1/10	10	56	R6	Erie 15
	Capacitars					
21-4528	Palyester	400V		.047µ	C1	Mullard C296-AC-A47K
21-1616	Ceramic	12V	10	0.1µ	C8,C22,C23	Murata DD.600.BC.12
21-5501	Feed thru				C19,C20,C21	Erie K2600/361
23-3030	Connector-BNC					Greenpar UG 1094/AU
17-0029	Switch-Rotary					Racal Inst.
	OSCILLATOR ASSEMBLY 11-0770 (See NOTE below)					
9400	5 MHz Fast warm up Oscillatar Type 9400					
19-0636	P.C.B. Assembly. See Parts List page 7-17					
23-3005	BNC Sockets, Bulkhead. 1 MHz Ext/Int.					Amphenol UG-1094/U
23-3074	Valve Base B7G					Carr Fastener
23-4042	Slide Switch d.p.d.t.					Racal Insts.

NOTE: In later models the components listed under Assembly 11-0770 are transferred to the Main Chassis Parts List.

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
	POWER SUPPLY ASSEMBLY 11-0565					
	NOTE: Components on the Stabiliser p.c.b. are shown in the Parts List 19-0433 and the Mains Filter in 19-0475.					
	Capacitors					
21-0587	Electrolytic	350V		33µ	C1	I.T.T. EN12.12
21-0577	Electrolytic	16V	-10+50	3300µ	C10	Mullard 071-15332
21-0576	Electrolytic	25V	-10+50	2200µ	C3, C13	Mullard 071-16222
21-0578	Electrolytic	16V	-10+50	10,000µ	C6	Mullard 071-15103
	Diodes					
22-1845	Volt Reg. (Stud Anode)		5	6.8V	D5	Texas IS.6006.A
22-1846	Volt Reg. (Stud Cathode)		5	6.8V	D8	Texas IS.6006.RA
	Transistors					
22-6012	Silicon npn (High Power)				Q6	Motorola 2N 3055
22-6016	Silicon npn (High Power)				Q2, Q9, Q12	R.C.A. 2N 3054
	Miscellaneous					
17-4027	Transformer				T1	Racal Instruments
19-0433	Power Supply Stabilizer Board					Racal Instruments
19-0475	Mains Filter Assembly					Racal Instruments
23-0000	Fuselink			60mA	FS1	Bulgin F270
23-0004	Fuselink			500mA	FS4, FS5	Bulgin F270
23-0005	Fuselink			750mA	FS2	Bulgin F270
23-0007	Fuselink			1.5A	FS3	Bulgin F270
23-0031	Fuselink Anti-Surge	200-250V		250mA	FS6	Bulgin F286/0.25
23-0022	Fuselink Anti-Surge	100-130V		500mA	FS6	Bulgin F286/0.50
23-0014	Fuse Holder (For FS6)					Bulgin F296
23-3036	Mains Inlet - 3 pin plug					Bulgin P429
23-3038	Socket (Free) - 3 way (mates with 23-3036)					Bulgin P430
23-9022	Voltage Selector					Carr Fastener 81/118

Cct Ref.	Description	Rat	Tal. %	Value	Component References	Manufacturer
	CHASSIS MOUNTED COMPONENTS: Parts List 11-0733					
	NOTE: The following miscellaneous items are not located on any single assembly. For Motherboard components refer to Parts List 19-0634.					
17-0051	Function Switch					Racal Instruments
23-4044	Switch: Hold/Reset s.p.d.t. Toggle				S2	Waycom MST205H
23-4043	Switch: Power d.p.d.t. Toggle				S3	Waycom MST205N
23-4042	Switch: Channel Select d.p.d.t.				S5	Jeanrenaud 51M
20-6593	Potentiometer inverse lag with switch: Sample Rate 500K				R1/S4	Erie 53
26-3007	Lamps: Standby and Overflow	12V		.06A	LP1, LP2	Thorn Bendix L1343
23-1015	Lamphalder for LP1, LP2 (Amber)					Slaan 102.SK1
23-3069	Socket: Probe Power					Sealectra D102A052
23-5125	Edge Connector 12 way					Carr. Fastener
	ATTENUATOR ASSEMBLY 19-0235 (Part of Assembly 11-0339)					
	Resistors	watt				
20-0220	Composition	1/10	10	22	R23	Erie 15
20-1501	Film	¼	1	100k	R3, R5	Erie 15
20-1502	Film	¼	1	910k	R2, R4	Erie 15
20-3104	Metal Oxide	½	5	100k	R1	Erie MO5
	Capacitors					
21-1008	Tantalum	15V	10	150µ	C7	S.T.C.472/LWA/403FAA
21-1515	Ceramic		10	39p	C4	Erie 831 N1500
21-1517	Ceramic		10	56p	C6	Erie 831 N1500
21-1526	Ceramic		10	330p	C2	Erie 831 N5600
21-6003	Trimmer			2-6p	C3, C5	Steatite Ins. 10S-Trika 06

Cct. Ref.	Description	Rat	Tal. %	Volue	Component References	Monufocturer
			PRE-AMPLIFIER ASSEMBLY, 19-0236			
			(Port af Assembly 11-0339)			
	Resistors	watts				
20-0100	Camposition	1/10	10	10	R19	Erie 15
20-0106	Camposition	1/10	10	10M	R7	Erie 15
20-0332	Compasitian	1/10	10	3.3k	R8	Erie 15
20-0330	Compasitian	1/10	10	33	R14	Erie 15
20-2102	Metal Oxide	¼	5	1k	R13	Erie MO4
20-2153	Metol Oxide	¼	5	15k	R16	Erie MO4
20-2221	Metal Oxide	¼	5	220	R9	Erie MO4
20-2271	Metol Oxide	¼	5	270	R20	Erie MO4
20-2332	Metal Oxide	¼	5	3.3k	R12	Erie MO4
20-2471	Metol Oxide	¼	5	470	R17	Erie MO4
20-2560	Metol Oxide	¼	5	56	R18	Erie MO4
20-2561	Metal Oxide	¼	5	560	R11	Erie MO4
20-2681	Metol Oxide	¼	5	680	R10	Erie MO4
20-2821	Metal Oxide	¼	5	820	R15	Erie MO4
	Capacitars					
21-1002	Tantalum	20V	20	10µ	C15,C17	Union Corbide K.10E20
20-1017	Tontolum			22µ	C12,C24	Mullord C421/AMDP22
21-1512	Ceromic			22p	C14	Erie 831 N470
21-4506	Palystyrene	100V		0.1µ	C9	Woycom MKS
21-1616	Ceromic	12V	10	0.1µ	C10,C11,C13, C16,C18	Murota DD.600.BC12
	Diodes					
22-1018	Silican				D5,D6	Hewlett-Pockord HPA2900
22-1029	Silican				D1,D2	S.T.C. IN 4149
22-1807	Voltoge Regulator	4.7V			D7	Mullord BZY88-C4V7
22-1809	Voltoge Regulatar	5.6V			D4	Mullord BZY88-C5V6
22-1811	Voltoge Regulotor	6.8V			D3	Mullard BZY88-C6V8

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
			19-0236 (continued)			
	Transistors					
22-6017	Silicon npn				Q2, Q4	Mullard 2N 2369
22-6039	Silicon npn				Q3, Q5	Mullard BFY 90
22-6040	F.E.T.				Q1	Motorola 2N 4416
22-6057	Silicon (used os diodes)				Q6, Q7	Ferranti ZTX 342
23-8000	Ferrite Beod				X1 (to be fitted to base of Q5) X2 (fitted on Collector of Q4)	Mullard FX 1214
			TIME BASE DIVIDER ASSEMBLY, 19-0352			
	Resistors	watts				
20-0102	Composition	1/10	10	1k	R2, R4	Erie 15
20-0472	Composition	1/10	10	4.7k	R1, R3	Erie 15
	Capacitors					
21-1003	Tantalum	10V	20	15μ	C1	Union Carbide K15E10
21-1616	Ceramic	12V	10	0.1μ	C2	Murata DD.600 BC12
	Integrated Circuits					
22-4044	Quod 2 input pos. Nand Gote				IC1	Motorola 7400
22-4049	Decade Counter				IC7, IC8, IC9, IC10, IC11, IC12, IC13	Motorola 7490
22-4053	Triple 3 input Ps. Nand Gate				IC2, IC3, IC6	Motorola 7410
22-4056	Duol 4 input Pos. Nond Gate				IC5	Motorola 7420
22-4055	Single 8 input pos. Nand Gate				IC4	Motorola 7430
	Transistors					
22-6017	Silicon npn				Q1, Q2	Motorola 2N 2369
			CONTROL CIRCUIT ASSEMBLY 19-0356			
	Resistors	watts				
20-0101	Composition	1/10	10	100	R23, R24	Erie 15
20-0102	Composition	1/10	10	1k	R15, R19, R32, R33, R34, R47, R49, R50, R52, R54	Erie 15

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
				19-0356 (continued)		
	Resistors					
20-0103	Composition	1/10	10	10k	R10,R16,R18,R20, R21,R28	Erie 15
20-0152	Composition	1/10	10	1.5k	R1,R4,R5,R7,R11, R46	Erie 15
20-0181	Composition	1/10	10	180	R30,R40	Erie 15
20-0222	Composition	1/10	10	2.2k	R2,R6,R13,R48	Erie 15
20-0821	Composition	1/10	10	820	R8	Erie 15
20-0392	Composition	1/10	10	3.9k	R29	Erie 15
20-0272	Composition	1/10	10	2.7k	R14	Erie 15
20-0471	Composition	1/10	10	470	R25,R31,R39	Erie 15
20-0123	Composition	1/10	10	12k	R45	Erie 15
20-0472	Composition	1/10	10	4.7k	R22,R36,R37, R38,R41,R42, R43,R44,R51	Erie 15
20-0681	Composition	1/10	10	680	R35	Erie 15
20-2102	Metal Oxide	¼	5	1k	R27	Erie MO4
20-2152	Metol Oxide	¼	5	1.5k	R26	Erie MO4
20-2221	Metol Oxide	¼	5	220	R3,R9,R12,R17	Erie MO4
20-2771	Metal Oxide	¼	5	270	R53	Erie MO4
	Capacitors					
21-1510	Ceramic		10	15p	C1,C4	Erie 831-N150
20-1513	Ceromic		10	27p	C2,C3	Erie 831-N650
21-1520	Ceromic		10	100p	C18	Erie 831-N3300
21-1532	Ceromic		20	1000p	C10,C12	Erie 831-K350081
21-1536	Ceromic		25	2200p	C9,	Erie 831-K7004
21-1616	Ceramic	12V		0.1µ	C5,C8,C14,C15, C16	Muroto DD 600 BC12
21-1508	Ceramic		±10	10p	C17	Erie 831-N.P.O.
21-1003	Tantolum	10V		15µ	C7	Union Corbide K15E10
21-1004	Tontolum	6.3V		22µ	C6,C13	Union Carbide K22E6
21-1545	Ceramic	25V	+50 -25	.01µ	C11	Erie 831/T/25V
	Diodes					
22-1029	Silicon				D1-D18 incl.	I.T.T. IN 4149
	Transistors					
22-6017	Silicon npn				Q1-Q7 incl., Q10,Q11,Q12,Q13, Q14,Q16,Q17,Q18, Q19	Motorolo SN 2369

Cct. Ref.	Description	Rot	Tol. %	Volue	Component References	Monufocturers
				19-0356 (continued)		
	Tronsistors					
22-6041	Silicon npn				Q8, Q15	Mullord BC109
22-6058	Silicon npn				Q9	Tronsitron TES-014
	Integroted Circuits					
22-4048	Duol 'D' Type Bistoble				IC1	Motorolo 7474
				AMPLIFIER GATING ASSEMBLY 19-0379		
	Resistors					
20-0102	Composition	1/10	10	1k	R43, R45, R47, R55, R60, R63	Erie 15
20-0103	Composition	1/10	10	10k	R59	Erie 15
20-0121	Composition	1/10	10	120	R7, R39	Erie 15
20-0151	Composition	1/10	10	150	R5	Erie 15
20-0222	Composition	1/10	10	2.2k	R6	Erie 15
20-0181	Composition	1/10	10	180	R14	Erie 15
20-0182	Composition	1/10	10	1.8k	R49	Erie 15
20-0221	Composition	1/10	10	220	R50, R53	Erie 15
20-0272	Composition	1/10	10	2.7k	R8, R48, R51	Erie 15
20-0331	Composition	1/10	10	330	R42	Erie 15
20-0152	Corbon Film	1/5	10	1.5k	R54	Mullard CR16
20-0333	Composition	1/10	10	33k	R2, R64	Erie 15
20-0391	Composition	1/10	10	390	R22	Erie 15
20-0470	Composition	1/10	10	47	R34, R62	Erie 15
20-0471	Composition	1/10	10	470	R16, R38	Erie 15
20-0472	Composition	1/10	10	4.7k	R15	Erie 15
20-0680	Composition	1/10	10	68	R21	Erie 15
20-0681	Composition	1/10	10	680	R57, R58	Erie 15
20-0682	Composition	1/10	10	6.8k	R1	Erie 15
20-0821	Composition	1/10	10	820	R9, R17	Erie 15
20-2101	Metol Oxide	¼	5	100	R29, R33	Erie MO4
20-2102	Metol Oxide	¼	5	1k	R12, R20, R31, R35	Erie MO4
20-2181	Metol Oxide	¼	5	180	R3	Erie MO4
20-2221	Metol Oxide	¼	5	220	R37, R46, R61	Erie MO4
20-2222	Metol Oxide	¼	5	2.2k	R36	Erie MO4
20-2271	Metol Oxide	¼	5	270	R30, R32	Erie MO4
20-2331	Metol Oxide	¼	5	330	R41	Erie MO4
20-2391	Metol Oxide	¼	5	390	R18	Erie MO4
20-2560	Metol Oxide	¼	5	56	R13, R23	Erie MO4
20-2471	Metol Oxide	¼	5	470	R10, R27	Erie MO4

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
				19-0379 (continued)		
	Resistors					
20-2681	Metal Oxide	¼	5	680	R28	Erie MO4
20-2820	Metal Oxide	¼	5	82	R11, R19	Erie MO4
20-4049	Metal Oxide	¼	2	3.9k	R24	Electrasil TR4
20-4066	Metal Oxide	¼	2	8.2k	R26	Electrasil TR4
20-6543	Variable			2.2k	R25	Plessey 404/8/02854/ NP
	Capacitors					
21-1513	Ceramic		20	27p	C26	Erie 831-N650
21-1508	Ceramic			10p	C31	Erie 831-NPO
21-1547	Ceramic		+50-25	.033μ	C32	Erie 831/T/18V
21-1515	Ceramic		20	39p	C12, C19	Erie 831/N1500
21-1520	Ceramic		20	100p	C2	Erie 831-N3300
21-1522	Ceramic		20	150p	C29	Erie 831-N3300
21-1526	Ceramic		20	330p	C3	Erie 831-N5600
21-1517	Ceramic		20	56p	C33	Erie 831-N1500
21-1616	Ceramic	12V	10	0.1μ	C1, C4, C5, C7, C9, C14, C15, C16, C21, C25, C28, C30, C34-C37 incl. C40	Murata DD.600.BC.12
21-1003	Tantalum	10V		15μ	C6, C8, C10, C17	Union Carbide K15E10
21-1004	Tantalum	6V		22μ	C27	Unian Carbide K22E6
21-1017	Tantalum	15V		22μ	C38, C39	Mullard C421/AM/FP4.7
21-0514	Tantalum	6V		500μ	C13, C20	Hunts MEF15AT
21-6000	Trimmer			10/40p	C11, C18	Steatite Ins. 10STriko06
	Transistors					
22-6018	Silican pnp				Q1	Motarola MPS 3640
22-6017	Silican npn				Q6-Q21 incl	Motorola 2N2369
22-6009	Silicon npn				Q3, Q5,	Motarala 2N4124
22-6019	Silicon npn				Q2, Q4	Mullard 2N 918
	Diades					
22-0001	Germanium				D5, D10, D12	Hughes HD 1870
22-1029	Silicon				D1, D4, D11	I.T.T. 1N 4149
22-1809	Voltage Regulatars 5.6V				D9	Mullard BZY 88-C5V6
22-1810	Voltage Regulators 6.2V				D7	Mullard BZY 88-C6V2
22-1814	Voltage Regulators 9.1V				D2, D3, D6, D8	Mullard BZY 88-C9V2

Cct. Ref.	Description	Rot	Tol. %	Volue	Component References	Manufacturer
			19-0379 (continued)			
	Miscelloneous					
23-8000	Ferrite Bead				X1, X2, X3, X4	Mullord FX 1242
		NOTE: X4 on Emitter of Q8				
23-7012	Inductor			4.7µH	L1, L2	Pointon 58/10/0009/10
			POWER SUPPLY STABILIZER BOARD: 19-0433			
			(Port of Power Supply Assembly 11-0565)			
	Resistors	wotts				
20-3224	Metal Oxide	¼	5	220k	R1	Welwyn MR5
20-0474	Compasition	1/10	10	470k	R2, R3	Erie 15
20-0100	Campositian	1/10	10	10	R4, R12, R19, R26	Erie 15
20-0470	Composition	1/10	10	47	R5	Erie 15
20-0471	Composition	1/10	10	470	R6, R13	Erie 15
20-2332	Metal Cxide	¼	5	3.3k	R7, R29	Erie MO4
20-6546	Varioble	¼	20	10k	R8, R30	Plessey 404/8/02857/MP
20-2472	Metol Oxide	¼	5	4.7k	R9, R31	Erie MO4
20-2222	Metol Oxide	¼	5	2.2k	R10, R32	Erie MO4
20-0103	Composition	1/10	10	10k	R11, R18, R25	Erie 15
20-2100	Metol Oxide	¼	5	10	R14	Erie MO4
20-2121	Metol Oxide	¼	5	120	R15, R23	Erie MO4
20-6541	Varioble	¼	20	470	R16, R22	Plessey 404/8/02857/MP
20-2681	Metal Oxide	¼	5	680	R17, R21	Erie MO4
20-0151	Camposition	1/10	10	150	R20, R27	Erie 15
20-2471	Metol Oxide	¼	5	470	R24	Erie MO4
20-0122	Compasitian	1/10	10	1.2k	R28	Erie 15
	Copocitors					
21-4515	Polyester	250V	20	0.22µ	C2	Rodio Resistar POM.A
21-1616	Ceromic	12V	10	0.1µ	C4, C5, C7-C9 incl., C11, C14, C15,	Muroto DD.600.BC.12
21-1002	Tontolum	20V	20	10µ	C12	Union Corbide K10E20
	Diodes					
22-1651	Bridge Rectifier	600V	2A		D1	Waycom VS.648
22-1650	Bridge Rectifier	200V			D2, D4, D6, D9	Woycom VS.248
22-1810	Voltoge Reg.	400mW	5	6.2V	D3, D7, D10	Mullard BZY88-C6V2

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
			19-0433 (continued)			
	Transistors					
22-6017	Silicon npn (High speed)				Q4,Q7,Q10	Motorolo 2N.2369
22-6041	Silicon npn (Low level)				Q1,Q3,Q8,Q11 Q13	Mullord BC109
22-6044	Silicon npn				Q5	S.G.S. BFY 51
23-0013	Fuseholder				FS1-FS5 incl	Bulgin F267/PC
			STANDARD READOUT ASSEMBLY (LATCHED) 19-0450			
	Resistors	watts				
20-0181	Composition	1/10	10	180	R2,R3,R4,R6	Erie 15
20-0222	Composition	1/10	10	2.2k	R5,R7,R8,R11, R12.	Erie 15
20-0562	Composition	1/10	10	5.6k	R1,R9,R10,R13, R14,R15,R16	Erie 15
20-0100	Composition	1/10	10	10	R17	Erie 15
20-2393	Metol Oxide	$\frac{1}{4}$	5	39k	R20	Erie MO4
	Copacitors					
21-1551	Ceramic	30V	+50-25	0.1µ	C1	Erie 811/T/30V
	Diodes					
22-1029	Silicon				D1	I.T.T. IN 4149
	Integrated Circuits					
22-4044	Quad 2 input Pos. Nand Gate				IC1	Motorola 7400
22-4049	B.C. Decade Count				IC3	Motorolo 7490
22-4051	Quad Latch				IC2	Motorola 7490
	Transistors					
22-6041	Silicon npn				Q2	Mullard BC 109
22-6057	Silicon npn Nixie Driver				Q3-Q12 incl.	Ferranti ZTX 342
	Indicators					
26-1013	Tube, Numerical Indicator (Nixie)					Hivac XN13
26-3003	Lamp, D.P.	4.5V			.06A	Vitality 670U/C

HIGH SPEED DECADE ASSEMBLY 19-0460

Cct. Ref.	Description	Rot	Tol. %	Volue	Component References	Monufocturer
	Resistors	wotts				
20-0101	Composition	1/10	10	100	R27	Erie 15
20-0102	Composition	1/10	10	1k	R36	Erie 15
20-0152	Composition	1/10	10	1.5k	R22,R24	Erie 15
20-0181	Composition	1/10	10	180	R4,R13,R15,R17	Erie 15
20-0221	Composition	1/10	10	220	R19,R34,R37	Erie 15
20-0222	Composition	1/10	10	2.2k	R2,R5,R6,R10, R18,R20,R26	Erie 15
20-0272	Composition	1/10	10	2.7k	R28	Erie 15
20-0331	Composition	1/10	10	330	R29	Erie 15
20-0471	Composition	1/10	10	470	R30,R33	Erie 15
20-0561	Composition	1/10	10	560	R23	Erie 15
20-0562	Composition	1/10	10	5.6k	R1,R3,R7,R8, R12,R14,R16, R31,R32	Erie 15
20-2221	Metol Oxide	¼	5	220	R21,R25,R35	Erie MO4
20-2393	Metal Oxide	¼	5	39k	R11	Erie MO4
	Capacitors					
21-1508	Ceromic		10	10p	C1,C6	Erie 831-N.P.O.
21-1512	Ceramic		10	22p	C3,C5	Erie 831-N470
21-1616	Ceromic		10	0.1µ	C2	Muroto DD 600 BC12
21-1003	Tontalum	10V		15µ	C4	Union Corbide K15E10
21-1515	Ceromic		20	39p	C7	Erie 831-N1500
	Diodes					
22-0001	Germonium				D2,D3,D4,D5	Hughes HD1870
22-1029	Silicon				D1,D6,D7,D8	I.T.T. IN 4149

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
			19-0460 (continued)			
	Transistors					
22-6017	Silicon npn				Q2, Q13, Q16, Q17, Q18, Q19, Q20	Motorola 2N 2369
22-6059	Silicon npn				Q14, Q15	Mullard BFX 89
22-6041	Silicon npn				Q1	Mullard BC 109
22-6057	Silicon npn Nixie Driver				Q3-Q12 incl.	Ferranti ZTX 342
	Integrated Circuits					
22-4044	Quad 2 input Pos. Nand Gate				IC1	Motorola 7400
22-4052	Dual 'D' Type Bistable				IC3, IC4	Motorola 7479
22-4051	Quadruple Latch				IC2	Motorola 7475
	Indicator Tube					
26-1013						Hivac XN 13
			MAINS FILTER 19-0475			
	Capacitors					
21-1540	Ceramic	500V	±25	4700p	C1, C2, C3	Erie 811
	Inductors					
17-4032	Choke, sub-miniature			250µH	L1, L2	Racal Instruments
			ATTENUATOR BOARD ASSEMBLY: 19-0620			
	Resistors	watts				
20-0121	Composition	1/10	10	120	R1, R2	Erie 15
20-0271	Composition	1/10	10	270	R3	Erie 15
20-0820	Composition	1/10	10	82	R4	Erie 15
	Capacitors					
21-1624	Ceramic	50V	20	0.1µ	C1	Erie 8133-203-Z5U
	Switch					
23-4060	Sensitivity, slide, 2 c/o				SA	Jeanrenaud 51MP

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
	REMOTE CONTROL ASSEMBLY 19-0628 (Option 02)					
	Resistors					
20-0102	Carbon Film	1/10	10	1k	R1-R10 incl.	Mullard CR16
20-0222	Carbon Film	1/10	10	2.2k	R11-R15 incl.	Mullard CR16
	Capacitors					
21-1616	Ceramic	12V		0.1μ	C1	Murata DD 600 BC12
	Transistors					
22-6017	Silicon npn				Q1-Q6 incl.	Motorola 2N 2369
	Integrated Circuits					
22-4045	Quad 2 input Pos. Nor Gate				IC1, IC5	Motorola 7402
22-4044	Quad 2 input Pos. Nand Gate				IC3, IC4	Motorola 7400
22-4053	Triple 3 input Pos. Nand Gate				IC2	Motorola 7410
	AMPLIFIER DIVIDER ASSEMBLY: 19-0630					
	Resistors	watts		ohms		
20-1527	Carbon Film	1/10	5	270	R1	Nutec RKL10
20-1525	Carbon Film	1/10	5	28	R2, R5	Nutec RKL10
20-0820	Composition	1/10	10	82	R3, R4, R36, R49	Erie 15
20-1530	Carbon Film	1/10	5	390	R6, R15	Nutec RKL10
20-1526	Carbon Film	1/10	5	22	R7	Nutec RKL10
20-0821	Composition	1/10	10	820	R8, R17, R35	Erie 15
20-1515	Carbon Film	1/10	5	180	R9, R14	Nutec RKL10
20-1541	Carbon Film	1/10	5	1.8k	R10, R19, R22	Nutec RKL10
20-1542	Carbon Film	1/10	5	4.7k	R11, R20, R23	Nutec RKL10
20-1517	Carbon Film	1/10	5	330	R12, R18, R21	Nutec RKL10
20-1531	Carbon Film	1/10	5	47	R13	Nutec RKL10
20-1529	Carbon Film	1/10	5	33	R16, R30	Nutec RKL10
20-1522	Carbon Film	1/10	5	12	R22, R28	Nutec RKL10
20-7009	Variable	¾		200	R24	Bourns 3009Y-1 (150ppm)
20-1544	Carbon Film	1/10	5	1.2k	R25	Nutec RKL10
20-1514	Carbon Film	1/10	5	100	R26	Nutec RKL10
20-2221	Metal Oxide	¼	5	220	R27	Erie MO4
— —	Composition	1/10	10	15 - 33	R31 [A.O.T.]	Erie 15
20-0102	Composition	1/10	10	1k	R32, R39, R40	Erie 15
20-0471	Composition	1/10	10	470	R33, R41, R43 R46, R47	Erie 15

Cct. Ref.	Description	Rot	Tol. %	Value	Component References	Manufacturer
				19-0630 (continued)		
	Resistors					
20-0220	Composition	1/10	10	22	R34	Erie 15
20-0153	Composition	1/10	10	15k	R37	Erie 15
20-0391	Composition	1/10	10	390	R38	Erie 15
20-0151	Composition	1/10	10	150	R42	Erie 15
20-2471	Metal Oxide	¼	5	470	R44	Erie MO4
20-2392	Metol Oxide	1/10	5	3.9k	R45	Erie MO4
20-0100	Composition	1/10	10	10	R48	Erie 15
	Capacitors					
21-1709	Ceromic (Monobloc)	100V	-20 +80	.01µ	C1, C5, C7, C11, C15, C19, C20, C22, C23, C24, C25, C28, C30, C35, C36	Erie 8123-000-Z5U
21-1626	Ceramic	100V	20	.01µ	C2, C6, C10, C12, C13, C14, C16, C18	Erie CMC-1A-Z5U
21-6004	Voriable			3.5/13p	C3, C8	Steatite 7S. Triko-02
— —	Ceromic		10	10-22p	C17 [A.O.T.]	Erie 831
21-302	Ceromic		10	22p	C21	Erie 8000-006-0220 C1
21-1616	Ceromic			0.1µ	C26, C27, C31, C34,	Murota DD.600.BC12
21-1000	Tontolum	15V	20	3.3µ	C32, C33	Union Corbide K3R3.E15
	Diodes					
22-1809	Voltage Reg.	5.6V			D1	Mullard BZY88-C5V6
22-2003	Tunnel				D2	R.C.A.40573
	Transistors					
22-6039	Silicon: npn				Q1, Q2, Q3, Q4, Q6, Q7,	Mullard BFY90
22-6058	Silicon: pnp				Q5	Transitron TES014
22-6017	Silicon: npn: 2N2369				Q8, Q9, Q10	Vorious
	Integrated Circuit					
22-4500	Divide-by-Ten				IC1	Racal Instruments

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
			19-0630 (continued)			
	Miscellaneous					
23-8000	Ferrite Bead				X1, X2, X3	Mullard FX1242
23-3126	P.C.B. mounted receptacle:			50Ω	SKT1	Sealectro Conhex 52/051/0000
			MOTHERBOARD ASSEMBLY 19-0634			
	Resistors	watts				
20-2471	Carbon Film	⅓	5	470	R1, R3, R5, R7	Mullard CR25
20-2181	Carbon Film	⅓	5	180	R2, R4, R6, R8, R13, R14, R15, R16, R20, R21	Mullard CR25
20-2821	Carbon Film	⅓	5	820	R10, R11, R12	Mullard CR25
20-2391	Carbon Film	⅓	5	390	R17	Mullard CR25
20-2681	Carbon Film	⅓	5	680	R18	Mullard CR25
20-2103	Carbon Film	⅓	5	10k	R19	Mullard CR25
20-2221	Carbon Film	⅓	5	220	R22	Mullard CR25
20-2472	Carbon Film	⅓	5	4.7k	R23	Mullard CR25
20-2102	Carbon Film	⅓	5	1k	R24	Mullard CR25
	Capacitors					
21-1510	Ceramic		10	15p	C1	Erie 831 N150
21-1528	Ceramic		10	470p	C2	Erie 831 K120051
21-1616	Ceramic	12V	10	0.1μ	C3	Murata DD.600.BC.12
	Diode					
22-1029	Silicon				D1	I.T.T. IN 4149
	Solid State Items					
22-4044	Integrated Circuit Quad 2 input pos. Nand Gate				IC1	Motorola 7400
22-4047	Integrated Circuit Dual Master-Slave JK Flip-Flop				IC2	Motorola 7473
22-6017	Transistor Silicon npn				Q1, Q2, Q3, Q4, Q5, Q6, Q7	Mullard 2N 2369
	Edge Connectors					
23-5104	10-way with key				SKT9, SKT10, SKT11, SKT12,	Carr Fastener
23-5112	18-way with key				SKT1 to SKT8 incl.	Permacon

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer
	OSCILLATOR P.C.B. ASSEMBLY: 19-0636					
	Resistors	watts	%			
20-2101	Carbon Film	1/3	5	100	R15, R20	Mullard CR25
20-2102	Carbon Film	1/3	5	1k	R25, R26, R27	Mullard CR25
20-2103	Carbon Film	1/3	5	10k	R24	Mullard CR25
20-2122	Carbon Film	1/3	5	1.2k	R10, R16	Mullard CR25
20-2182	Carbon Film	1/3	5	1.8k	R8, R12	Mullard CR25
20-2221	Carbon Film	1/3	5	220	R23	Mullard CR25
20-2222	Carbon Film	1/3	5	2.2k	R13	Mullard CR25
20-2272	Carbon Film	1/3	5	2.7k	R19, R21	Mullard CR25
20-2332	Carbon Film	1/3	5	3.3k	R9, R14	Mullard CR25
20-2391	Carbon Film	1/3	5	390	R30	Mullard CR25
20-2392	Carbon Film	1/3	5	3.9k	R22	Mullard CR25
20-2471	Carbon Film	1/3	5	470	R11, R17, R18	Mullard CR25
20-2560	Carbon Film	1/3	5	56	R28	Mullard CR25
20-2561	Carbon Film	1/3	5	560	R29	Mullard CR25
20-4011	Metal Oxide	¼	1	470	R31	Electrosil TR4
20-4063	Metal Oxide	¼	1	330	R32	Electrosil TR4
	Capacitors					
21-1003	Tontalum	10V	20	15µ	C3, C11	Union Carbide K15E10
21-1508	Ceramic	25V	-	10p	C12	Erie-Hunt 21103-100-0471-AH-0250
21-1514	Ceramic		10	33p	C7	Erie 831-N1500
21-1532	Ceramic		20	1000p	C4, C9	Erie 931-K350081
21-1616	Ceramic	12V	20	0.1µ	C2, C6, C8, C10	Murato DD.600.BC.12
21-2552	Silver Mica	350V	5	2200p	C5	Dubilier D20
21-5505	Polycarbonate	100V	20	0.47µ	C1	I.T.T. PMC1RO.47 M100
	Diodes and Tronsistors					
22-1029	Diode, Silicon				D1, D2, D3	I.T.T. 1N4149
22-6017	Transistor Silicon, npn				Q1 to Q6 incl.	Type 2N 2369
22-6044	Transistor Silicon, npn				Q7	S.G.S. BFY51
22-6058	Transistor Silicon pnp				Q8	Transitron TES014
	Integrated Circuits					
22-4049	B.C. Decade Counter				IC1	Type 7490
22-4044	Quad 2 input Pos. Nand Gote.				IC2	Type 7400

Cct. Ref.	Description	Rat	Tol. %	Value	Component References	Manufacturer

OPTIONS PARTS LIST SUMMARY

OPTION 01: DATA OUTPUT ASSEMBLY: 11-0650

10-2137	Cableform Assembly	Racal Instruments
23-3013	Socket: 50-way	Amphenol 57-40500

OPTION 02: DATA OUTPUT AND REMOTE CONTROL

NOTE: Option 02 also includes the items in Option 01 (above).

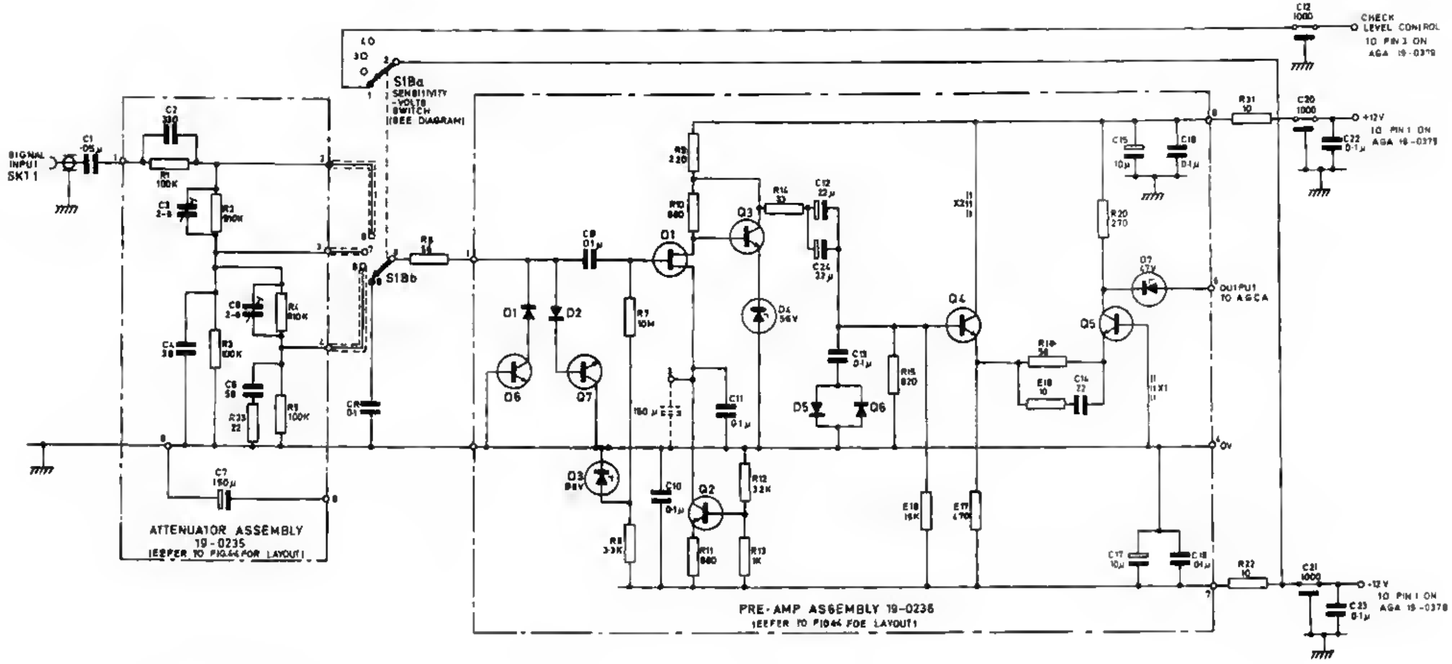
19-0628	Remote Control, Assembly (see page 7-14)	Racal Instruments
10-2136	Cableform Assembly (Remote Control)	Racal Instruments
23-3010	Socket: 14-way	Amphenol 57-40140

OPTION 04: ALTERNATIVE FREQUENCY STANDARD

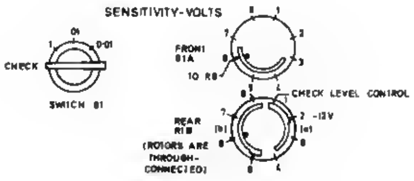
842	Fast Warm Up Oscillator: 5MHz	Racal Instruments

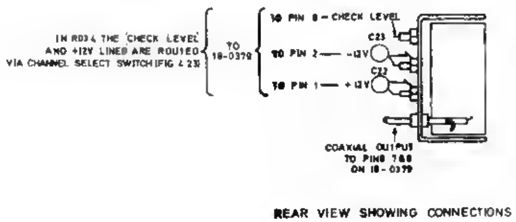
OPTION 06: EIGHT DIGIT READOUT

An additional Standard Readout Assembly Type 19-0450 is fitted.



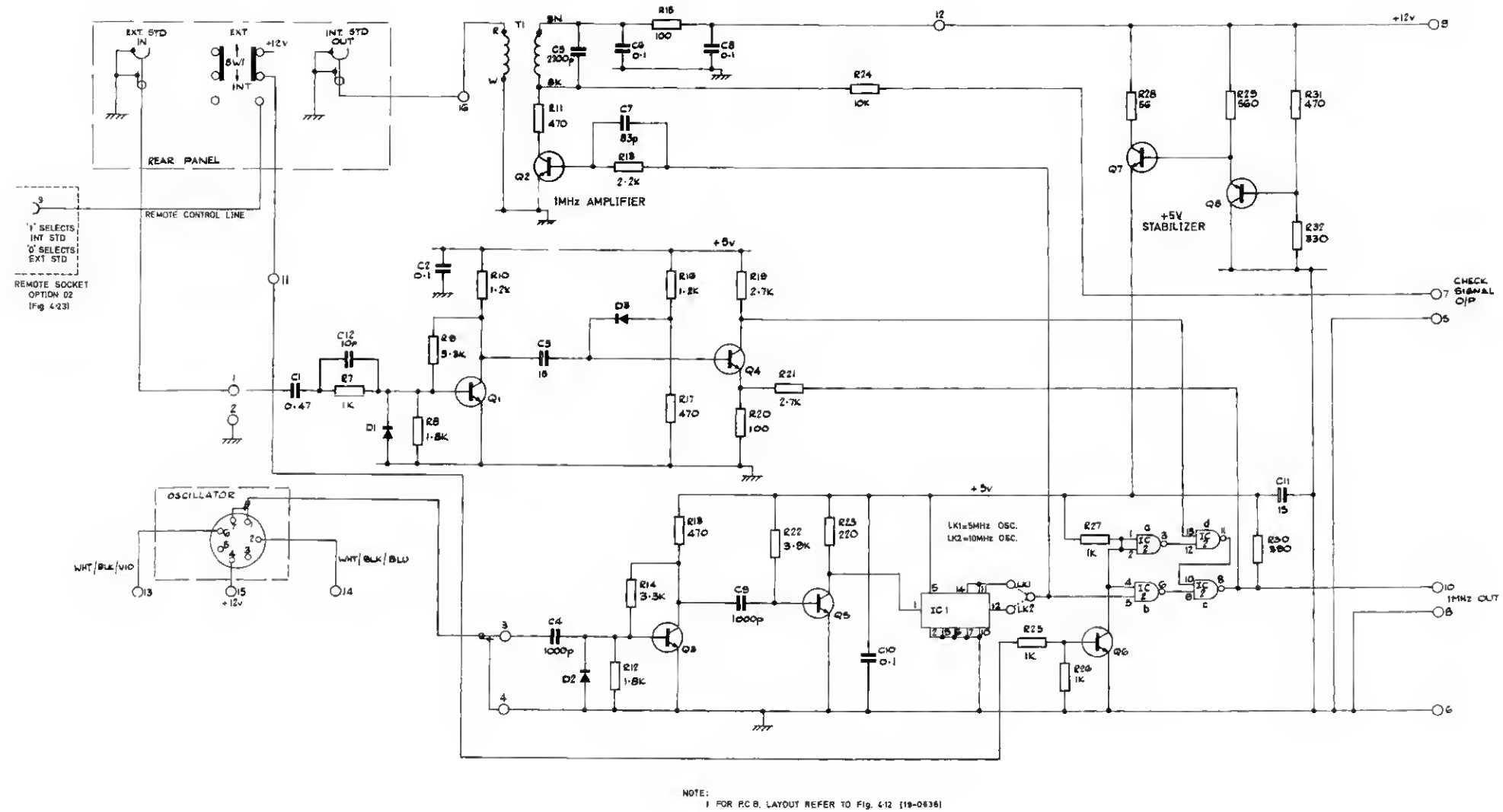
NOTES
1 UNLESS OTHERWISE INDICATED RESISTORS IN OHMS, CAPACITORS IN PICOFARADS.
2 CONNECTIONS NUMBERED CONSECUTIVELY FROM LEFT TO RIGHT FACING COMPONENT SIDE OF ASSY.





Circuit: Pre-Amplifier Assembly 11-0339

11-0339 Fig. 4.1



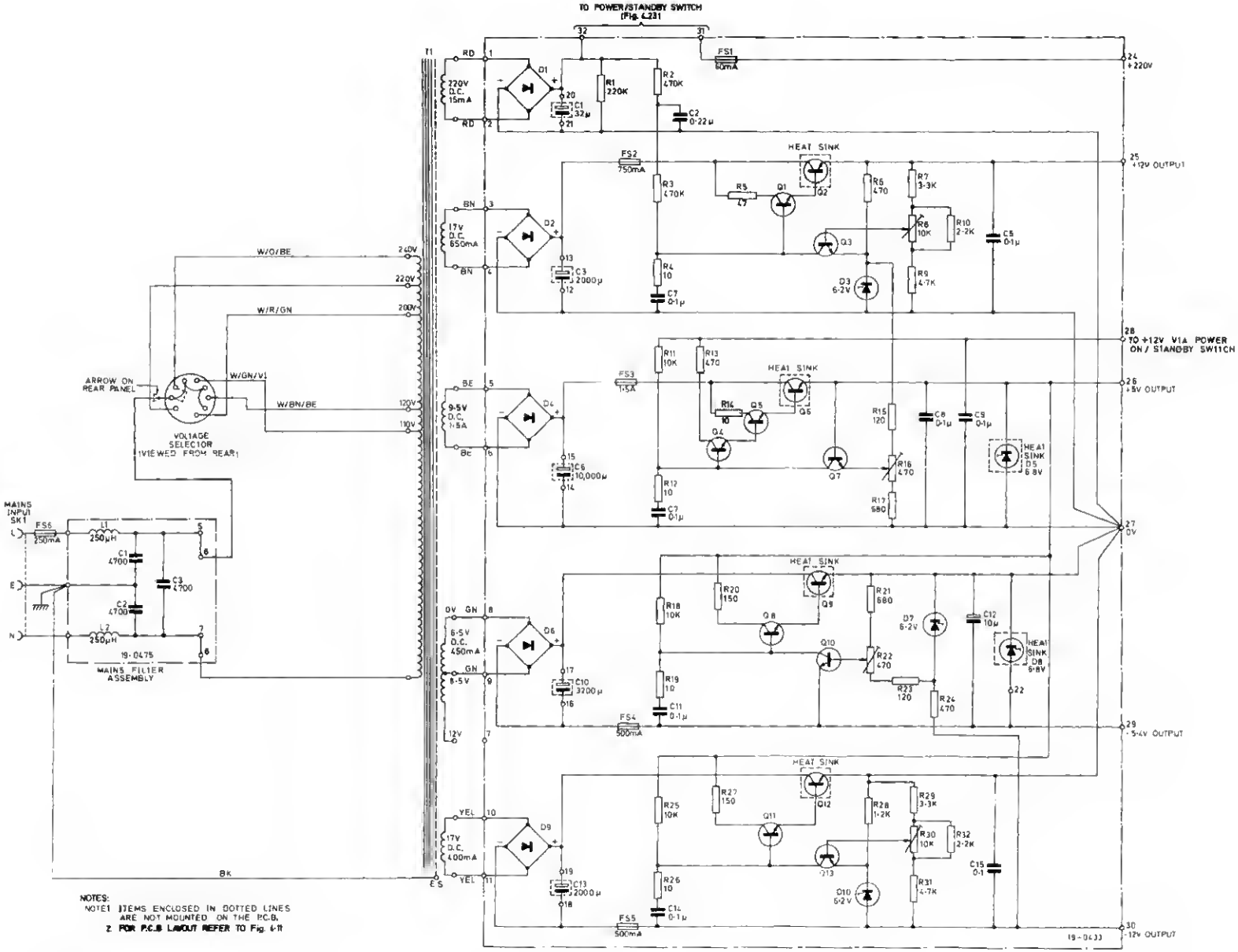
NOTE:
1 FOR P.C.B. LAYOUT REFER TO Fig. 4-12 (19-0636)

WOH2078 | 19-0636 | 1

Circuit: Frequency Standard Oscillator Assembly 19-0636

(WITH P.C.B. ASSEMBLY 19-0636)

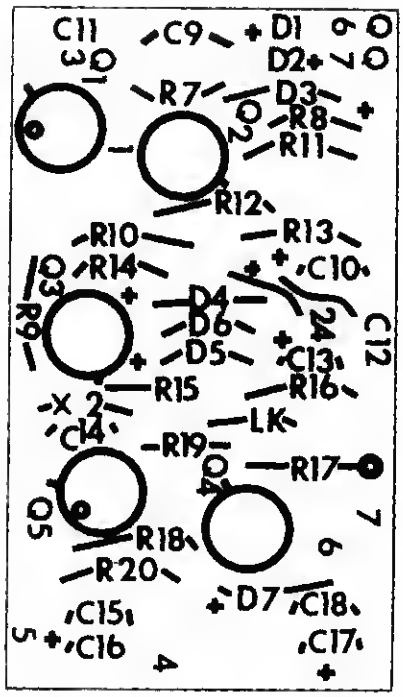
19-0636 Fig. 4·2



WOH 2078 | 11-0565
4|5

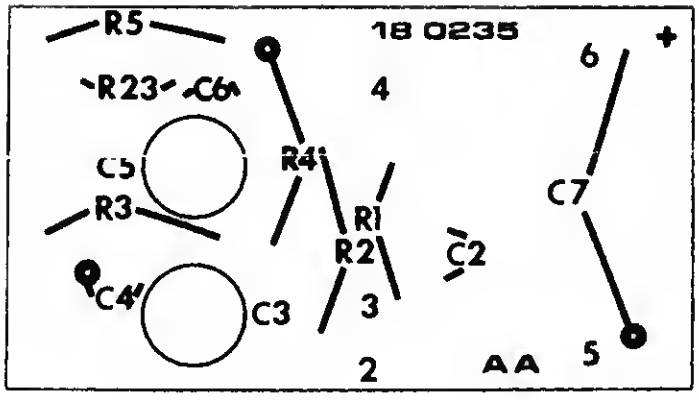
Circuit: Power Supply Assembly 11-0565

11-0565 Fig. 4-3



19-0236 2

Pre-Amplifier Board
19-0236



19-0235 2

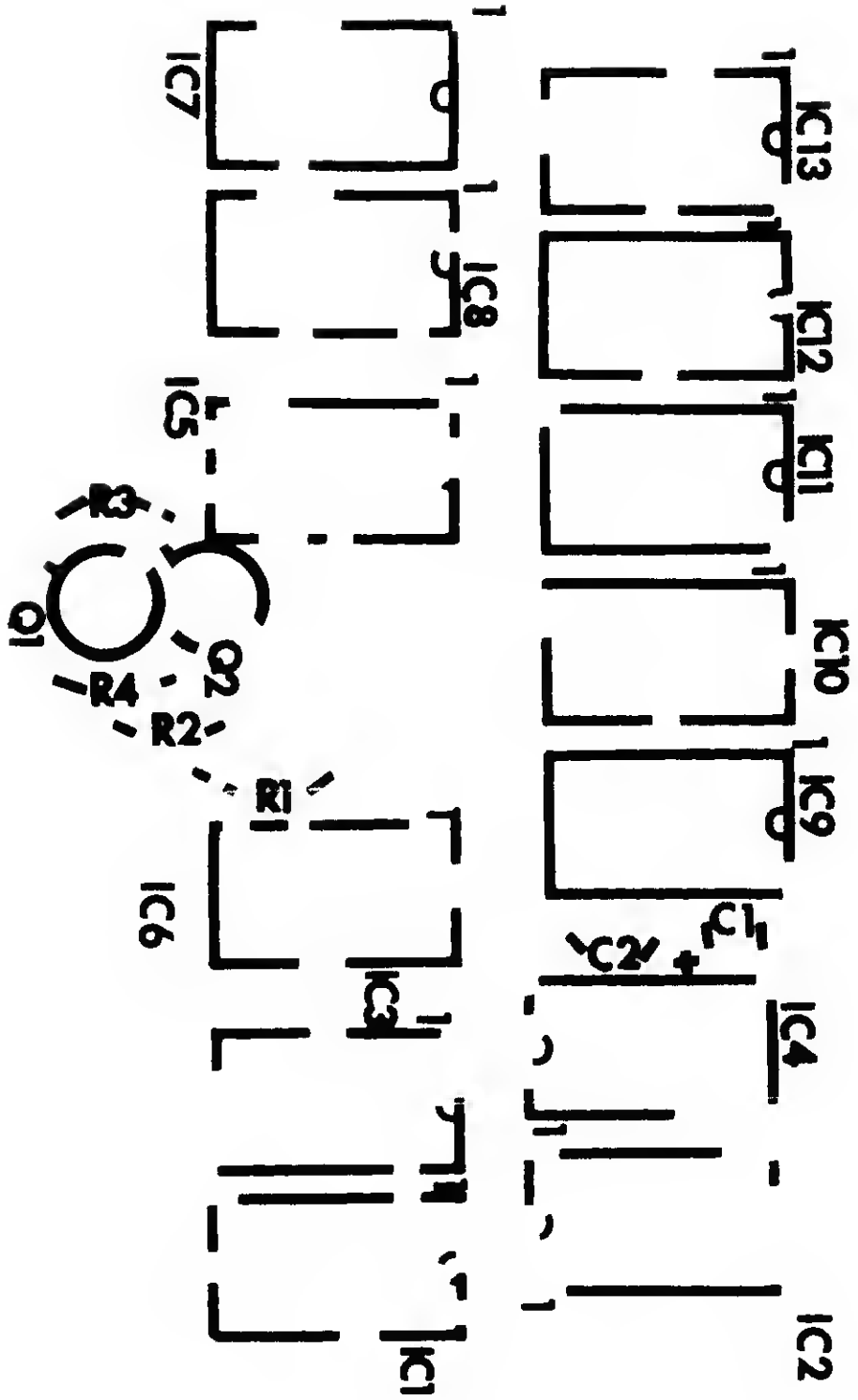
Attenuator Board
19-0235

WOH 2028

Layout : Attenuator and Pre-Amplifier Assemblies

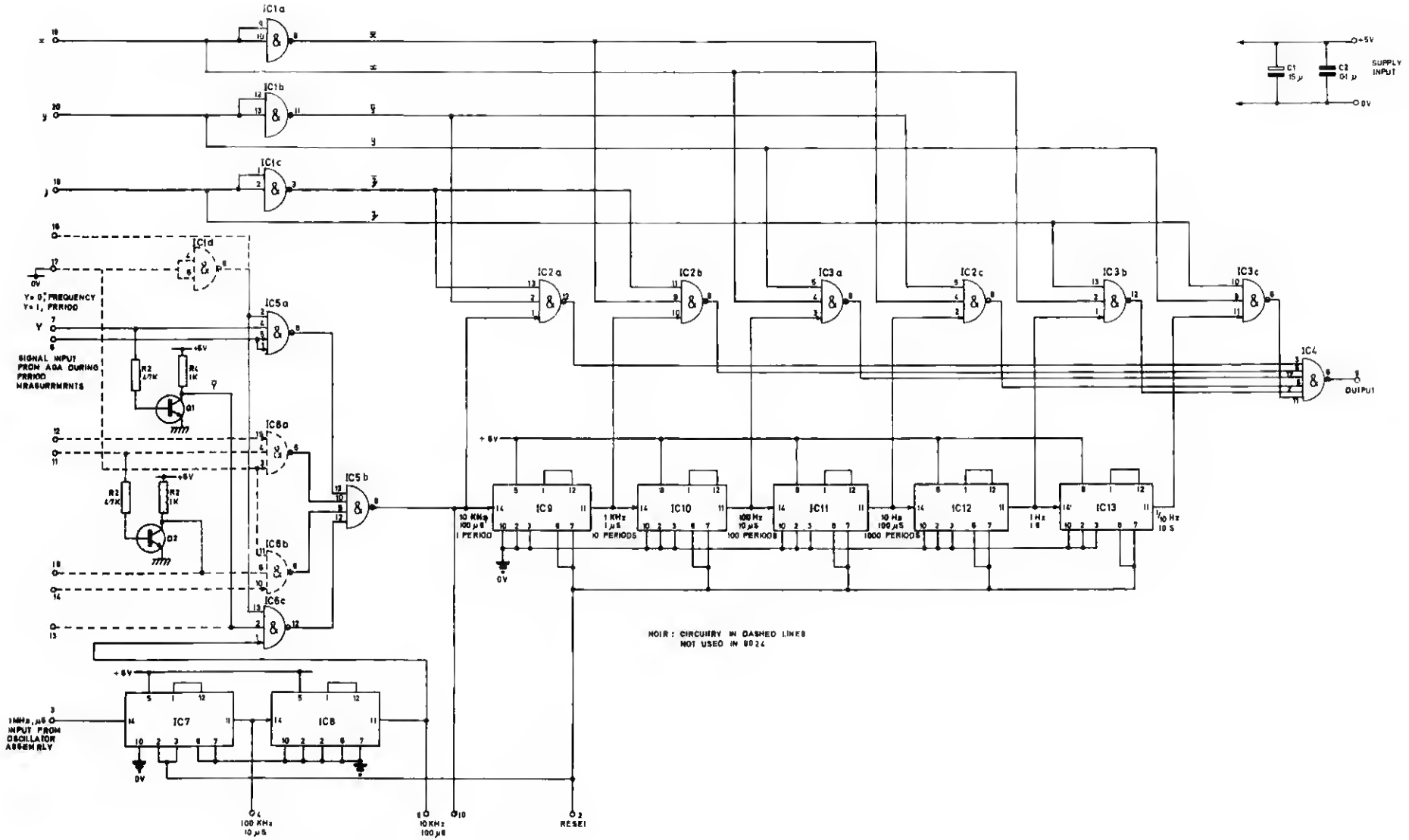
Fig. 4·4

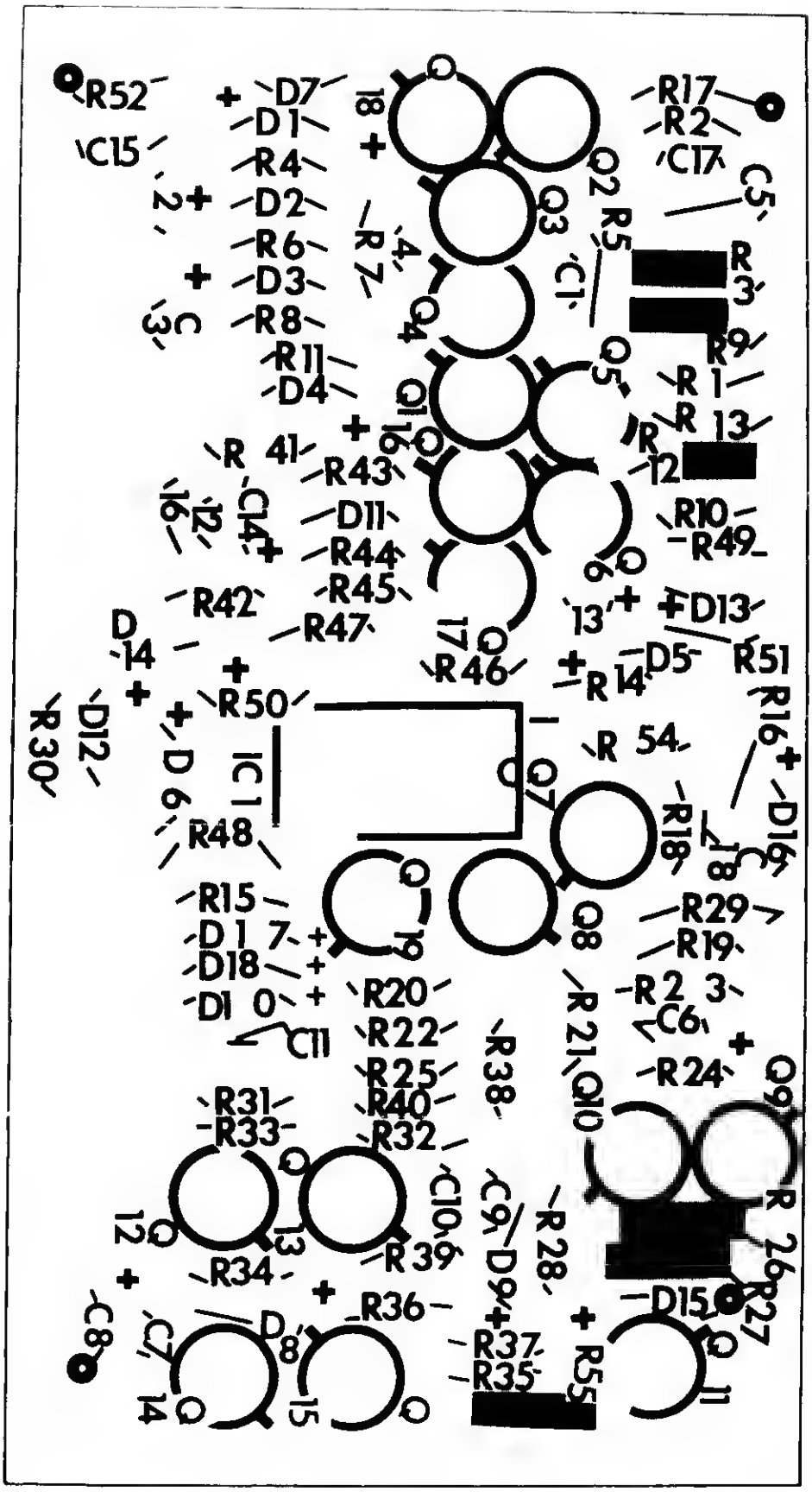
(PART OF PRE-AMPLIFIER ASSEMBLY 11-0339 Fig 4-1)



Layout: Time Base Divider Assembly
19-0352

Fig.4·5

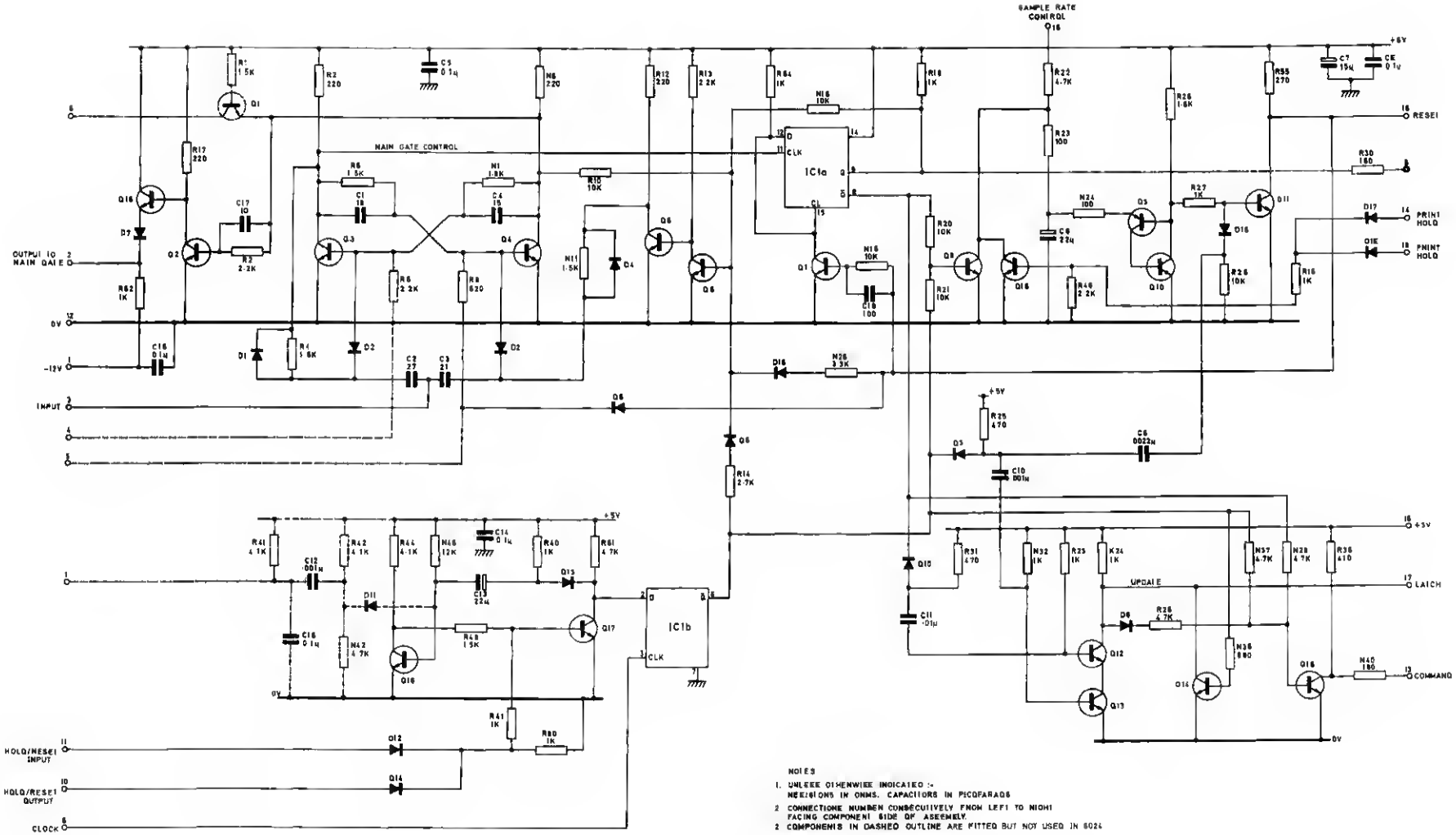

IC1a
IC1b
IC1c
IC1d
IC2a
IC2b
IC3a
IC2c
IC3b
IC3c
IC4
IC5a
IC5b
IC6a
IC6b
IC6c
IC7
IC8
IC9
IC10
IC11
IC12
IC13
+5V
0V
C1 15μ
C2 01μ
SUPPLY INPUT
OUTPUT
Y= 0, FREQUENCY
Y= 1, PRRIOD
SIGNAL INPUT FROM AGA DURING PRRIOD MRASURRMRNTS
R2 4.7K
R4 1K
Q1
Q2
1MHz, μS INPUT FROM OSCILLATOR ASSEMBLY
10 KHz 100 μS 1 PERIOD
1 KHz 1 μS 10 PERIODS
100 Hz 10 μS 100 PERIODS
10 Hz 100 μS 1000 PERIODS
1 Hz 1 S
1/10 Hz 10 S
100 KHz 10 μS
10 KHz 100 μS
RESET
NOTE: CIRCUITRY IN DASHED LINES NOT USED IN 8024



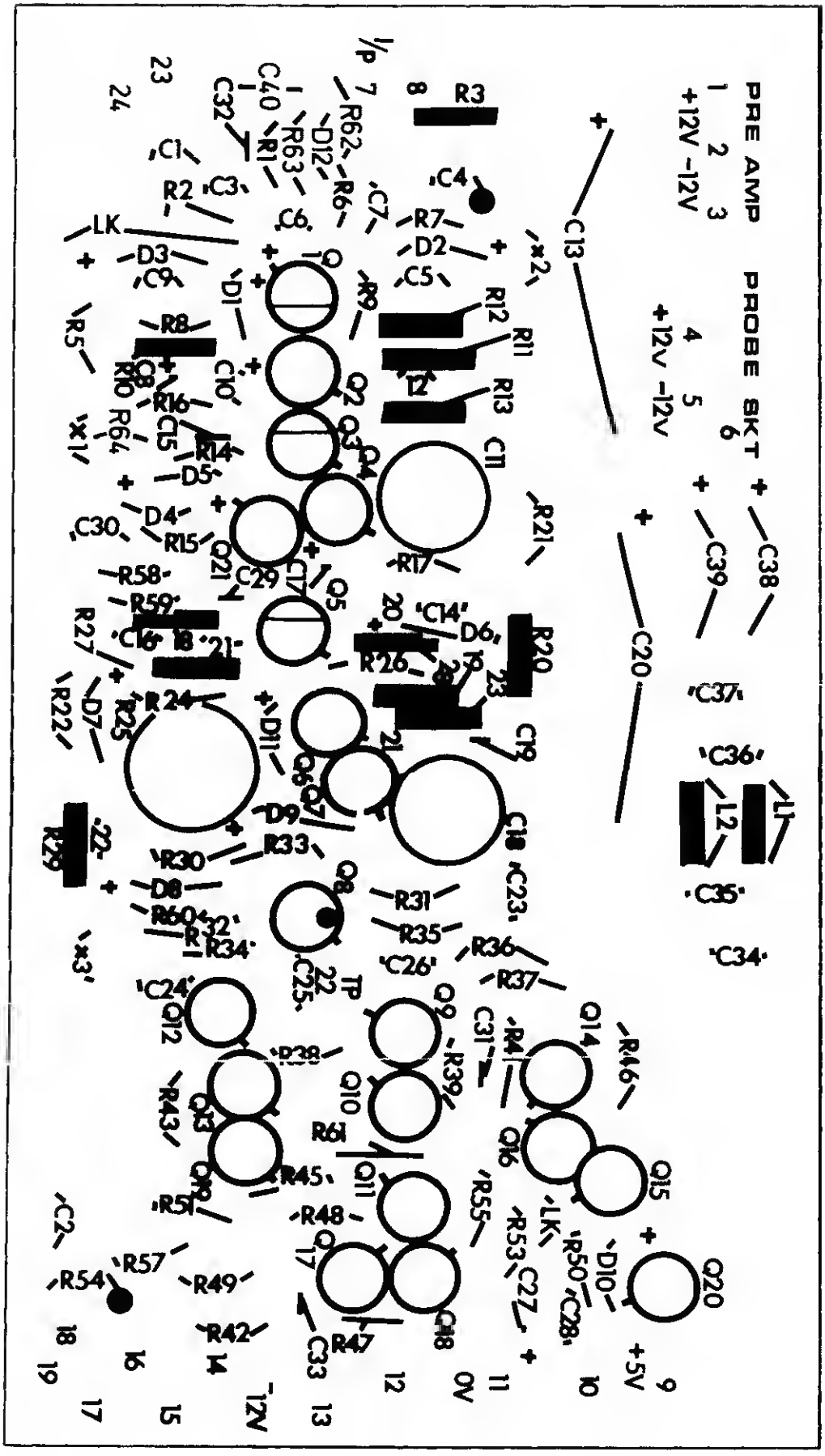
WOM 2078 19-0356 11

Layout : Control Circuit Assembly
19-0356

Fig. 4·7



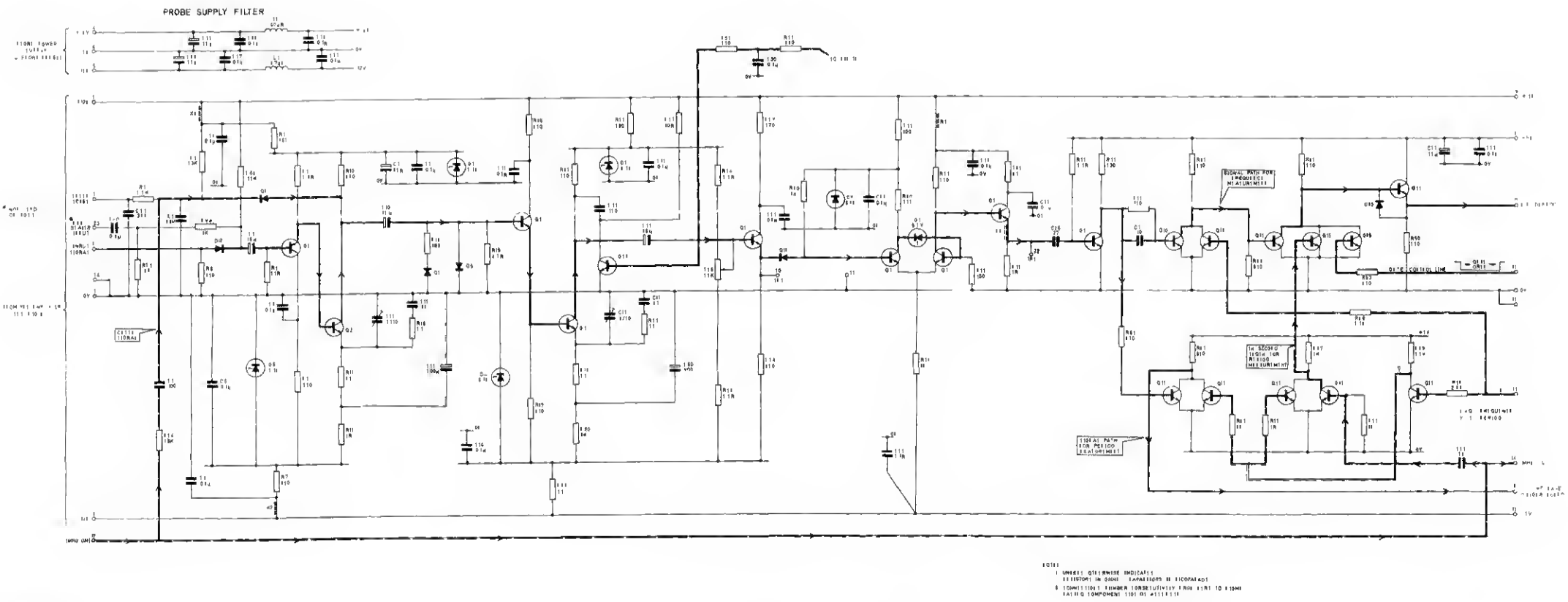
Circuit : Control Circuit Assembly 19-0356



WOH 2078 | 19 0379
1 2 3 4

Layout : Amplifier Gating Assembly
19-0379

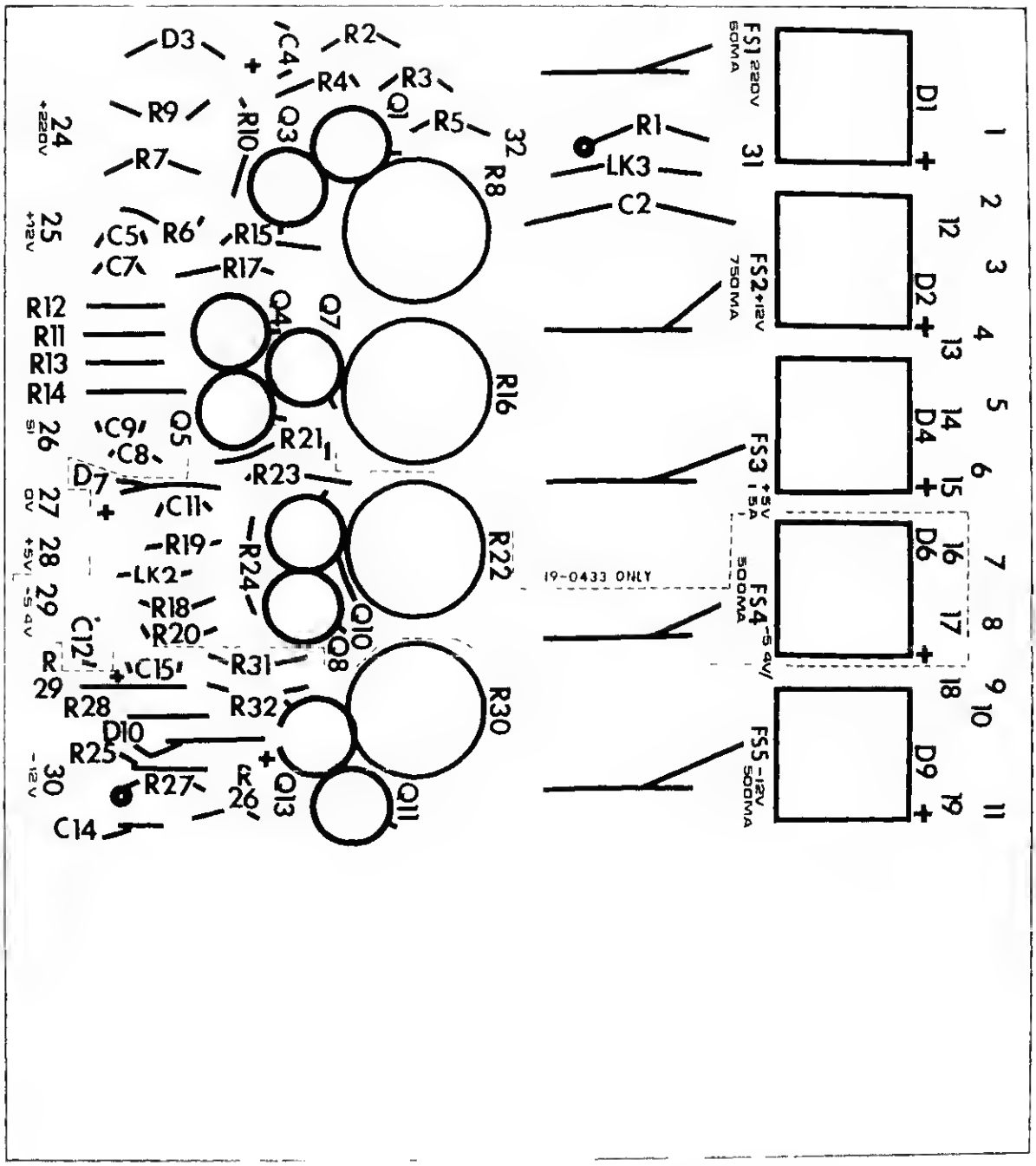
Fig. 4-9



Circuit : Amplifier Gating Assembly 19-0379

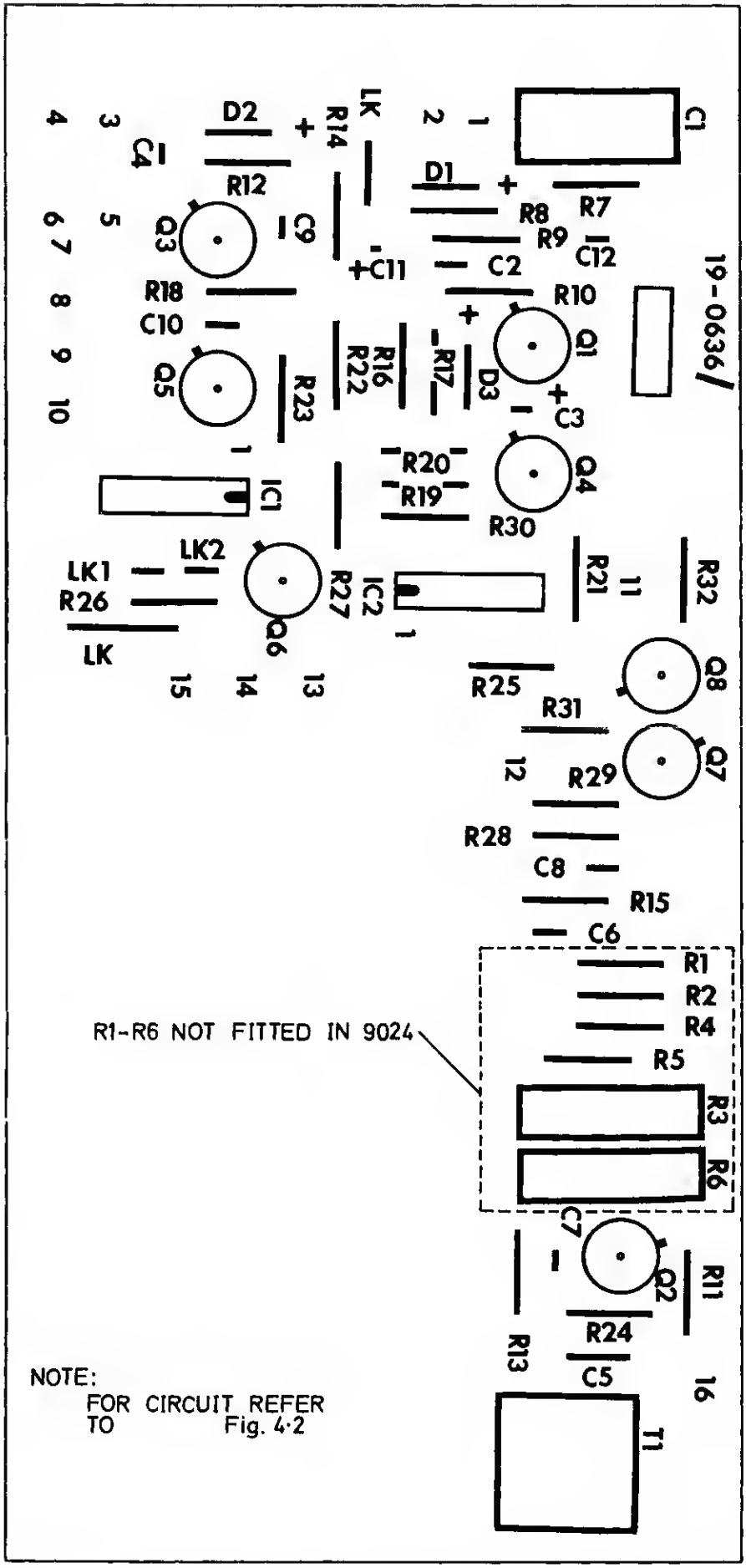
19-0379

Fig 4.10



WDH2078 19 0433 12

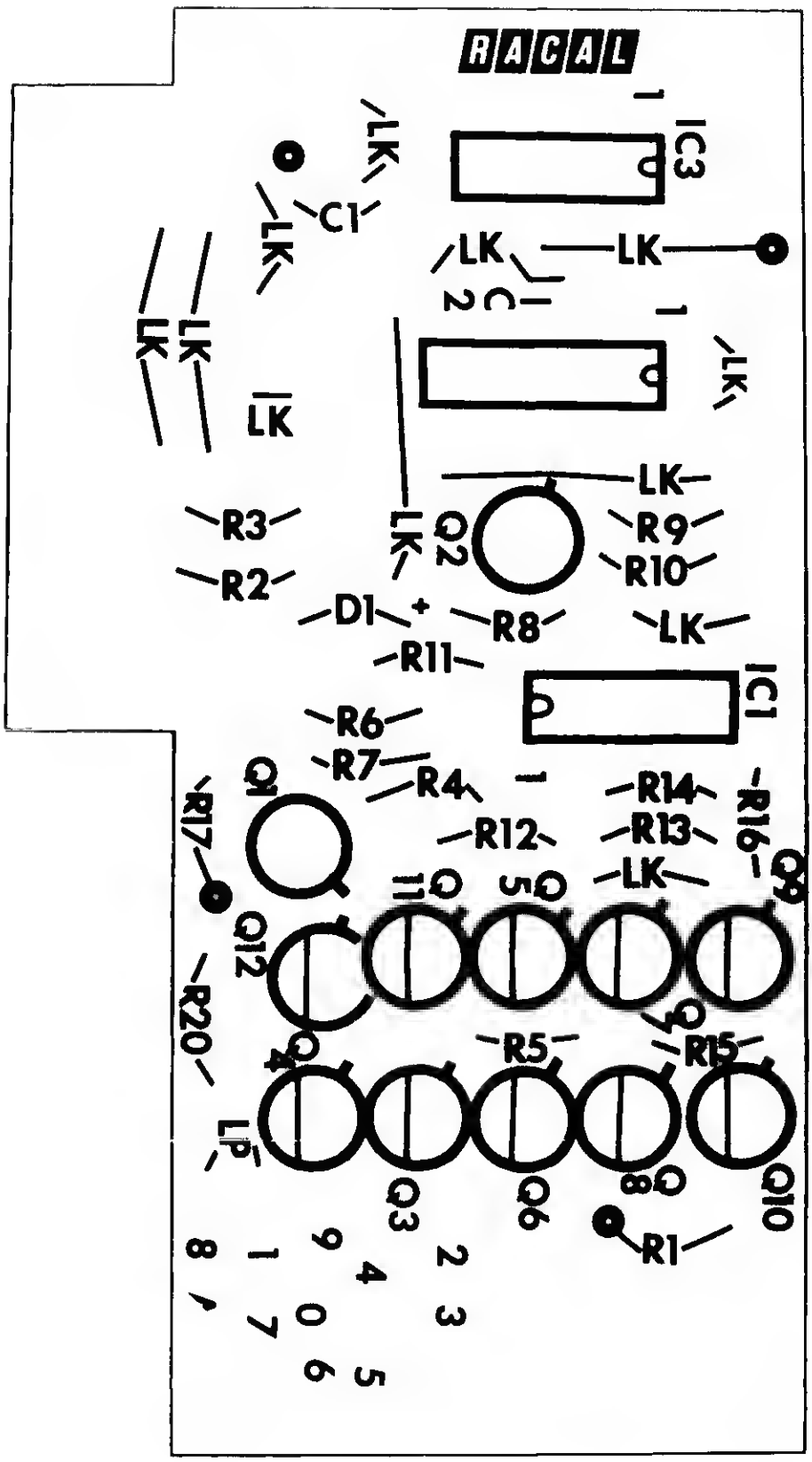
Layout Stabilised Power Supply 19-0433 Fig. 4·11



WOH2078	19-0636
1	

Layout: Oscillator P.C.B Assembly
19-0636

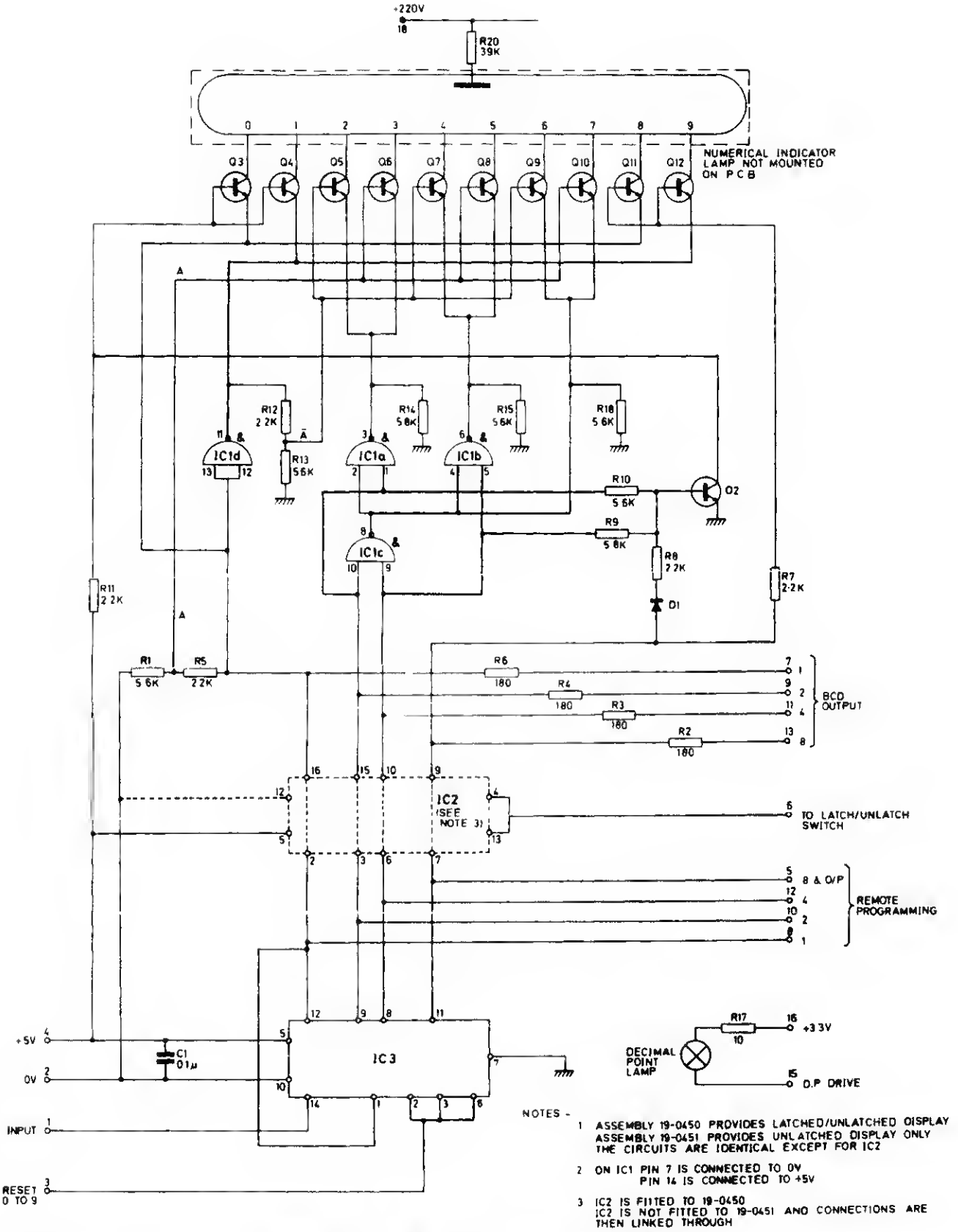
Fig. 4·12



WOH 2078 19-0450 P1

Layout : Readout Assembly (Latch)
19-0450

Fig. 4.13

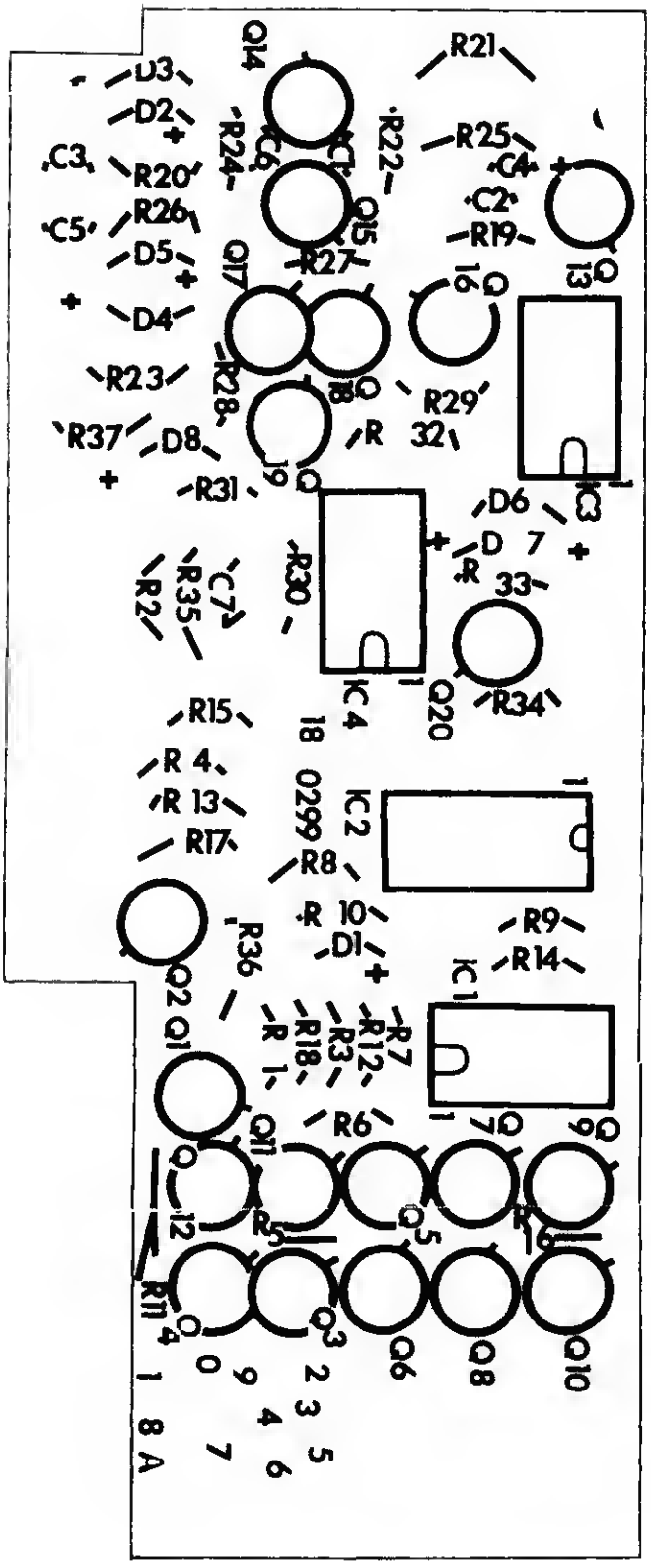


WOH 2078	19-0450/51
1	2

Readout Decade Assemblies Type 19-0450 & 19-0451

(ONLY 19-0450 IS FITTED WITH LATCHED DISPLAY)

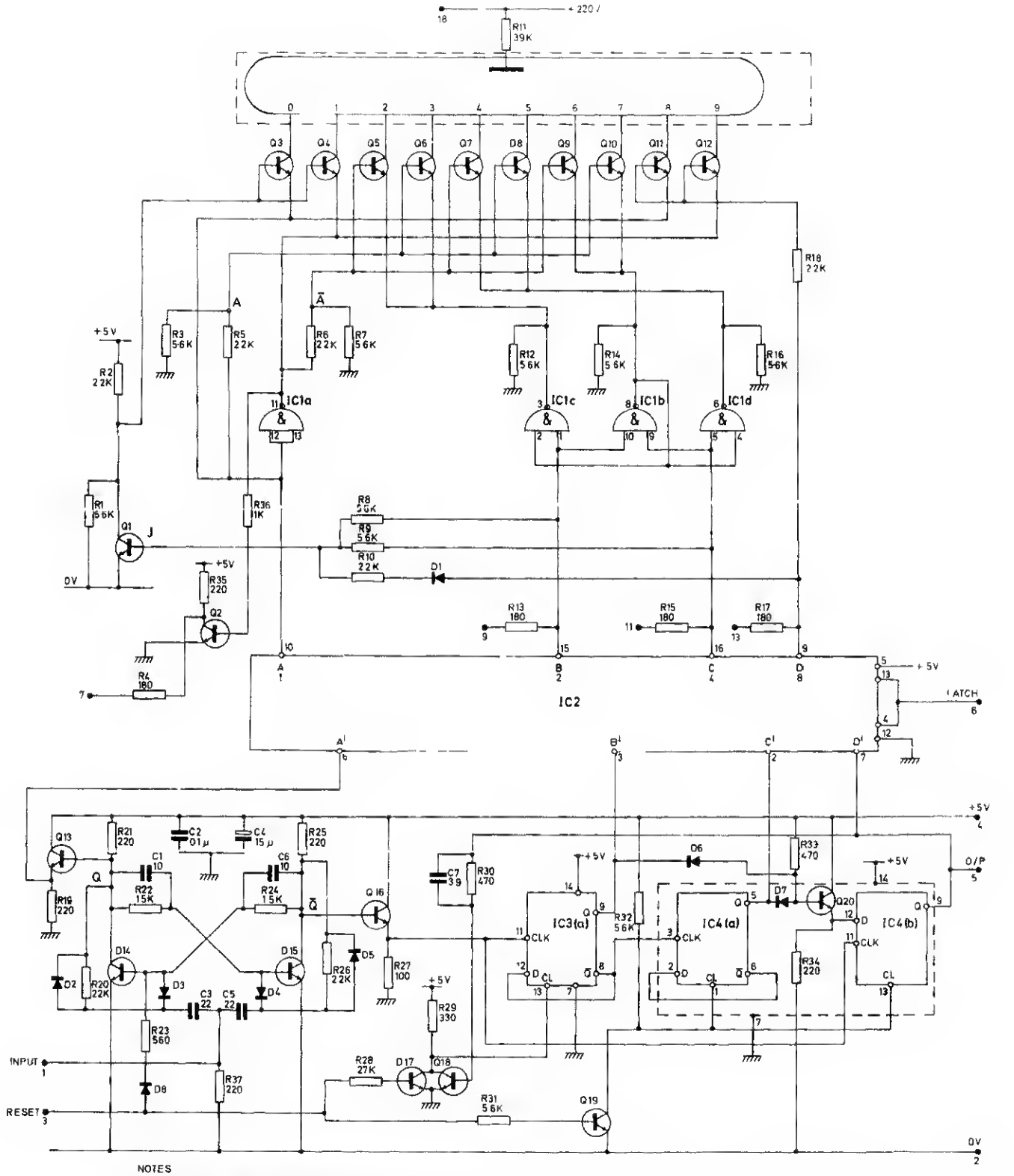
Fig. 4·14



WOH 2078 19-0460

Layout : High Speed Decade Assembly
19-0460

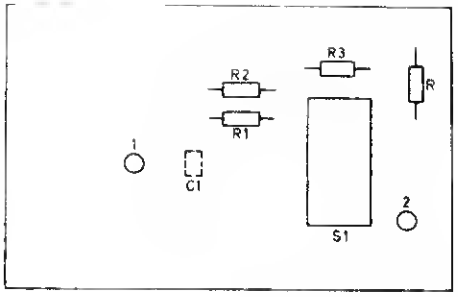
Fig. 4.15



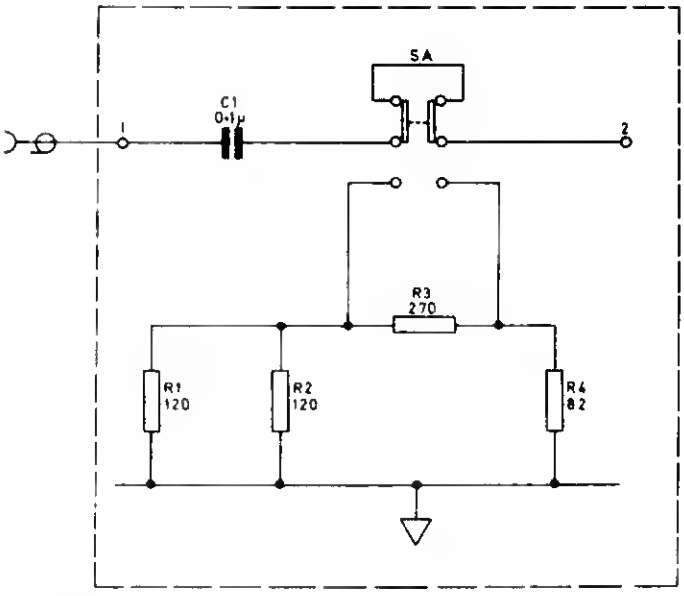
WOH 2078 19-0460

High Speed Decade 19-0460

Fig. 4.16



19-0620/1
1

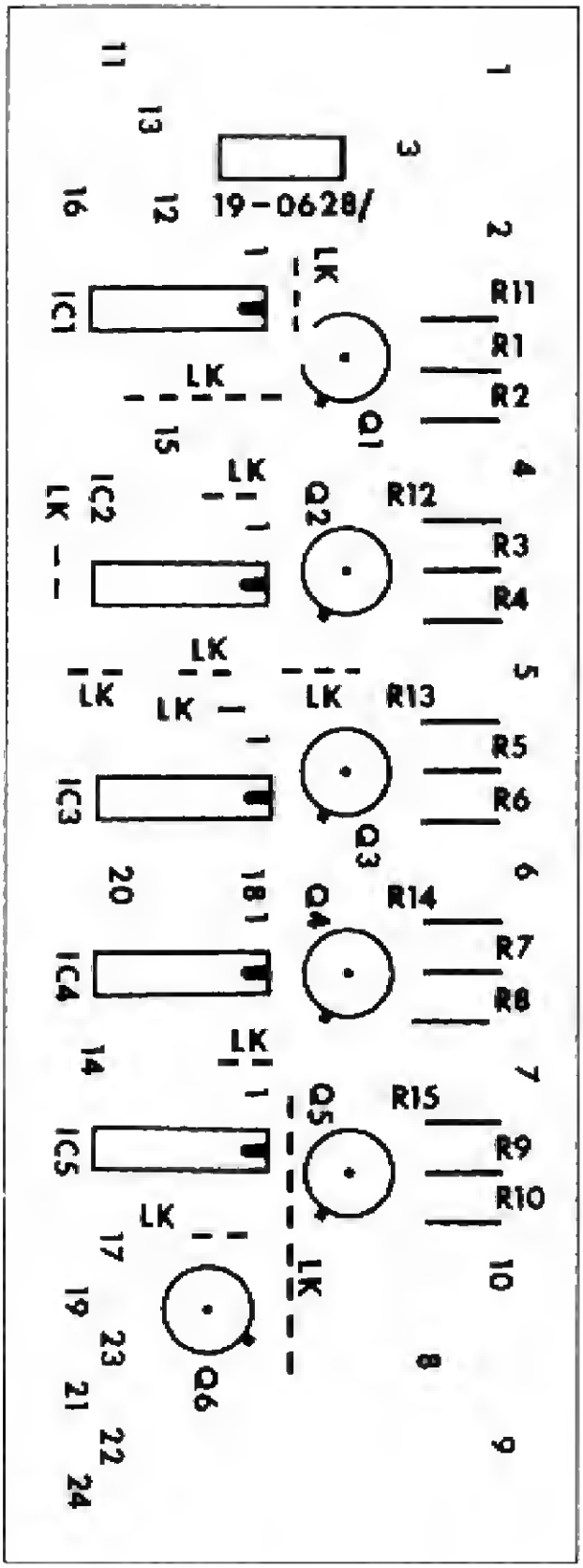


19 062072
1

WQH 2078 | 19-0620
1

Circuit and Layout
Attenuator Assembly : 19-0620

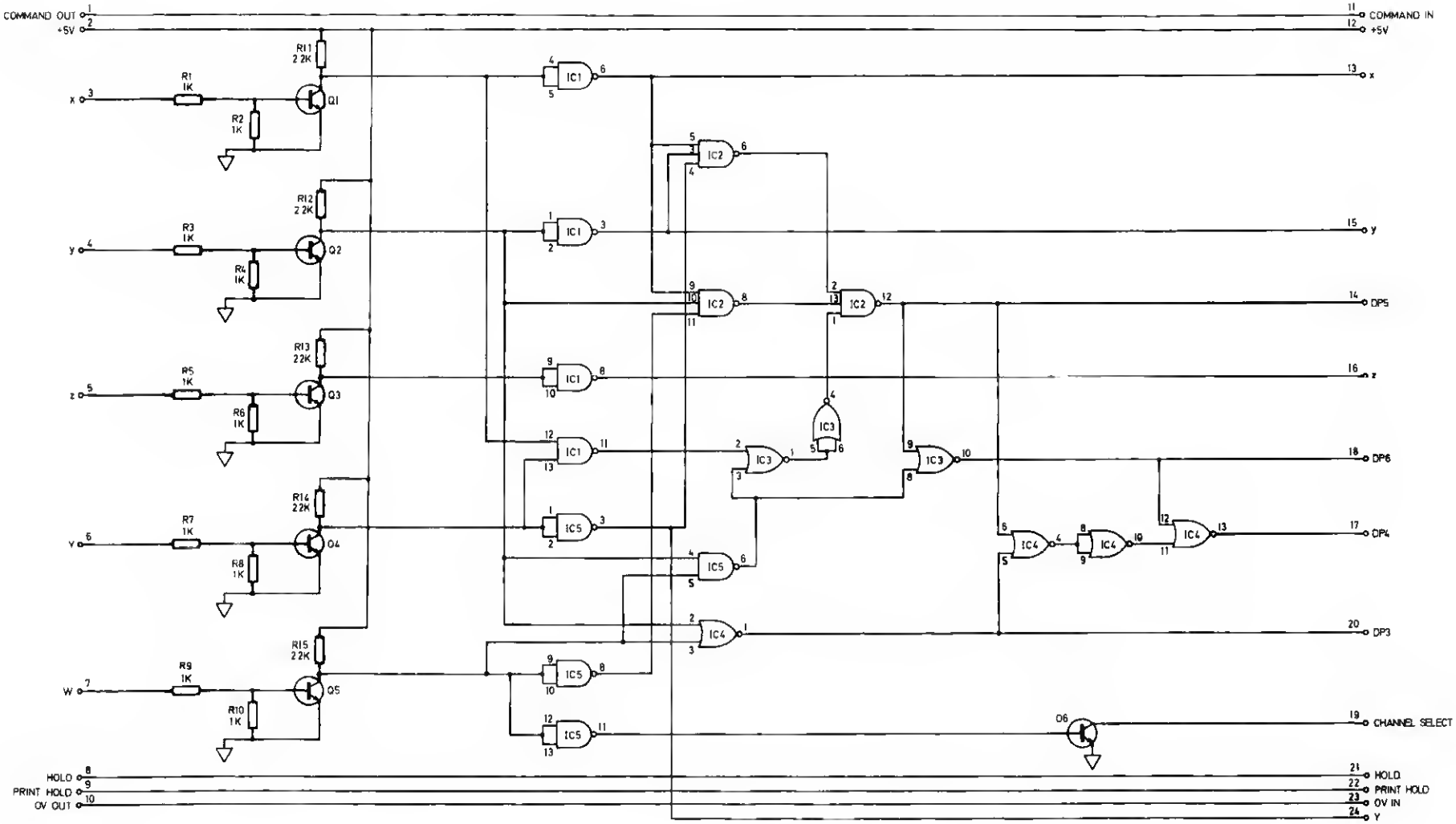
Fig.4·17



WOH 2078	19-0628
1	

Layout Remote Control
Assembly 19-0628

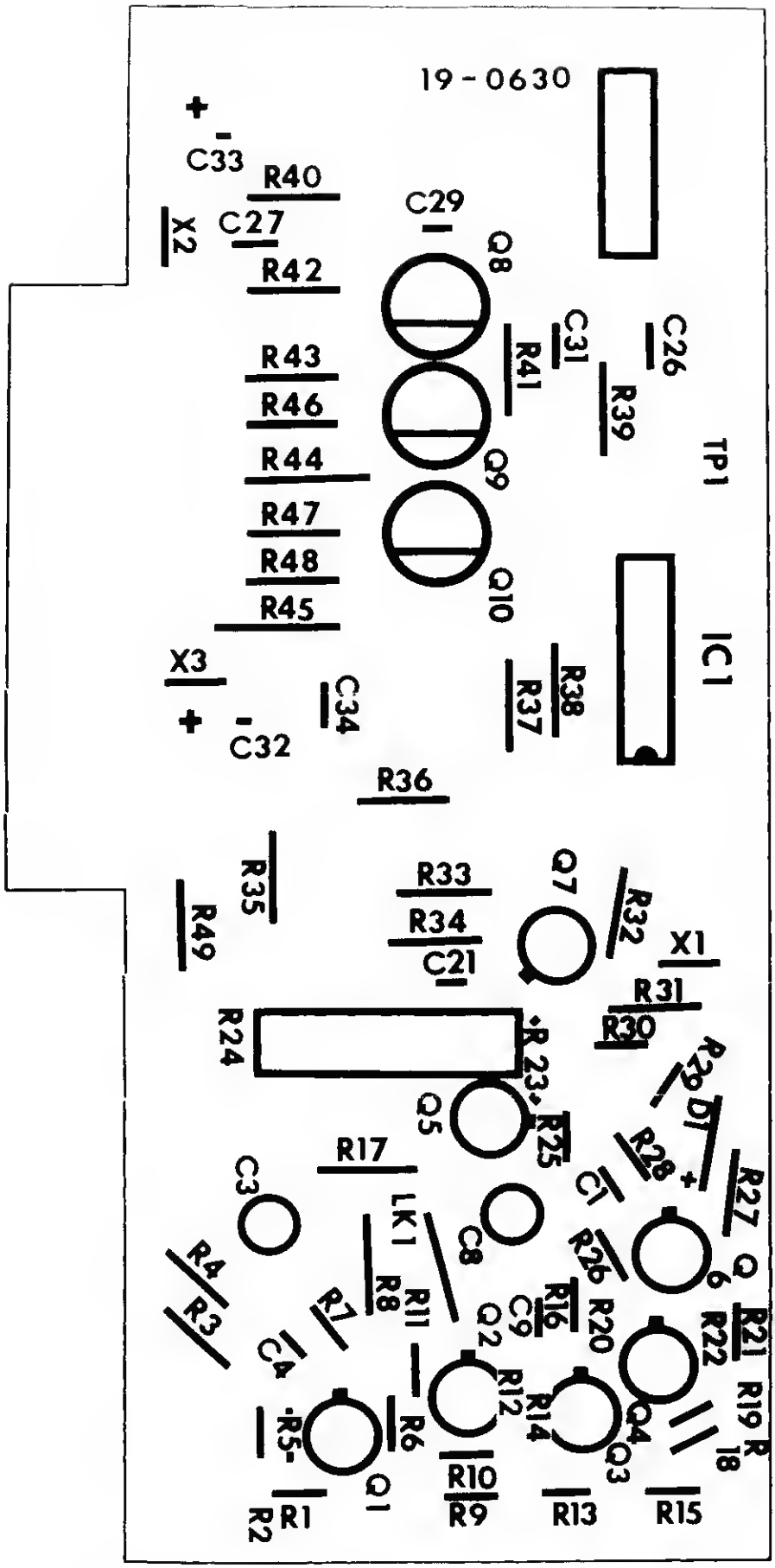
Fig. 4-18



WOH 2078 | 19-0628

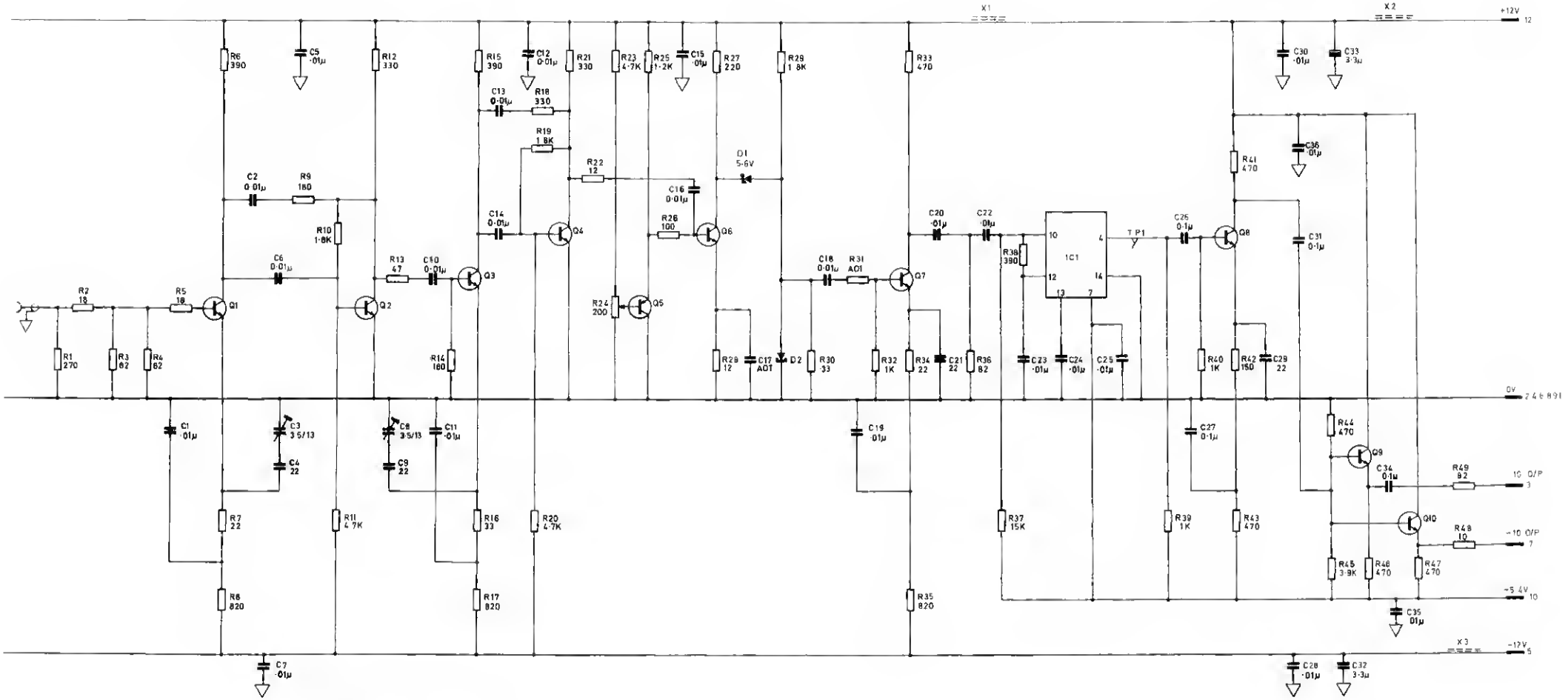
Circuit: Remote Control Assembly 19-0628

Fig. 4·19



Layout : Amplifier Divider Assembly
19-0630

Fig.4·20



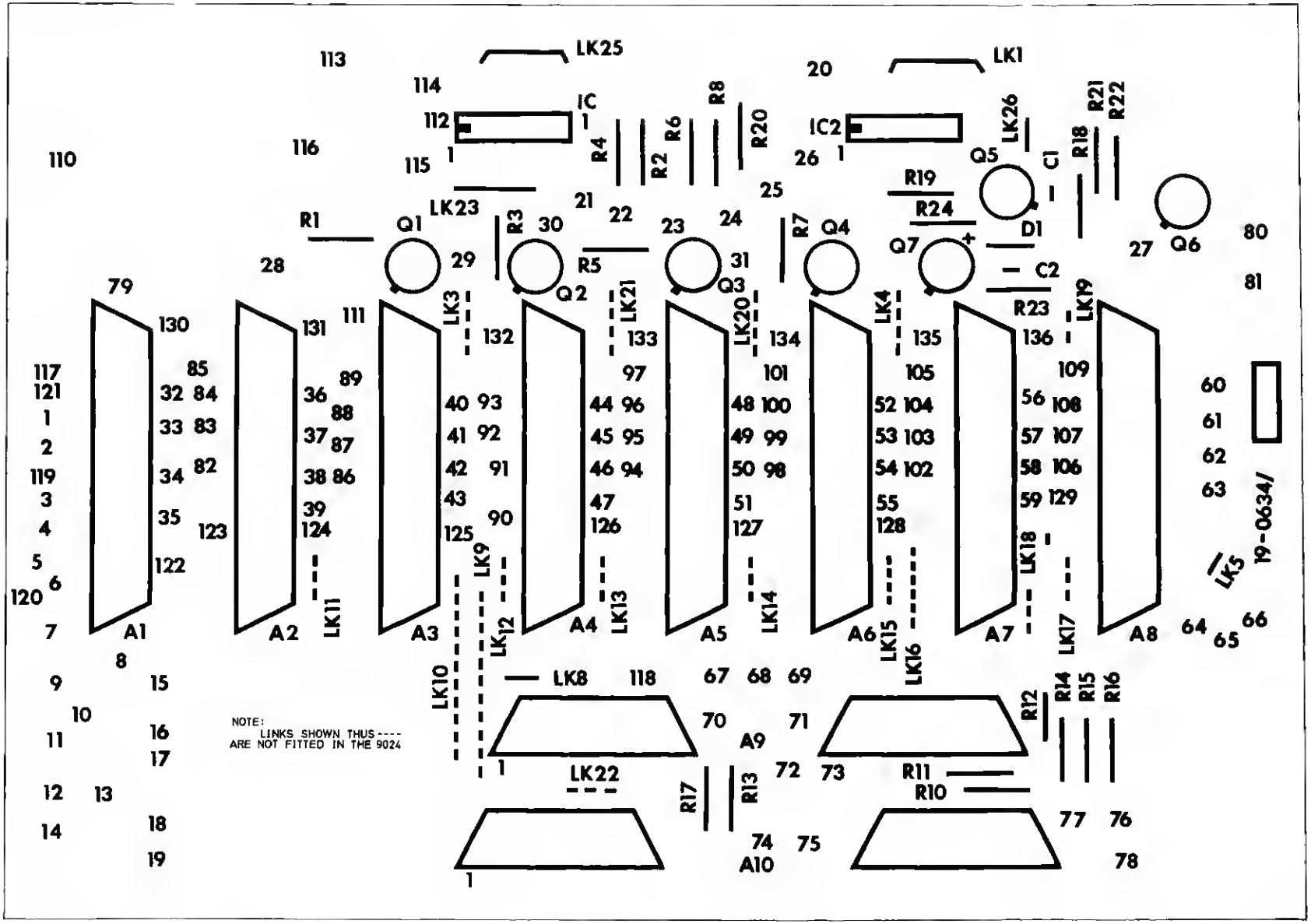
NOTES:

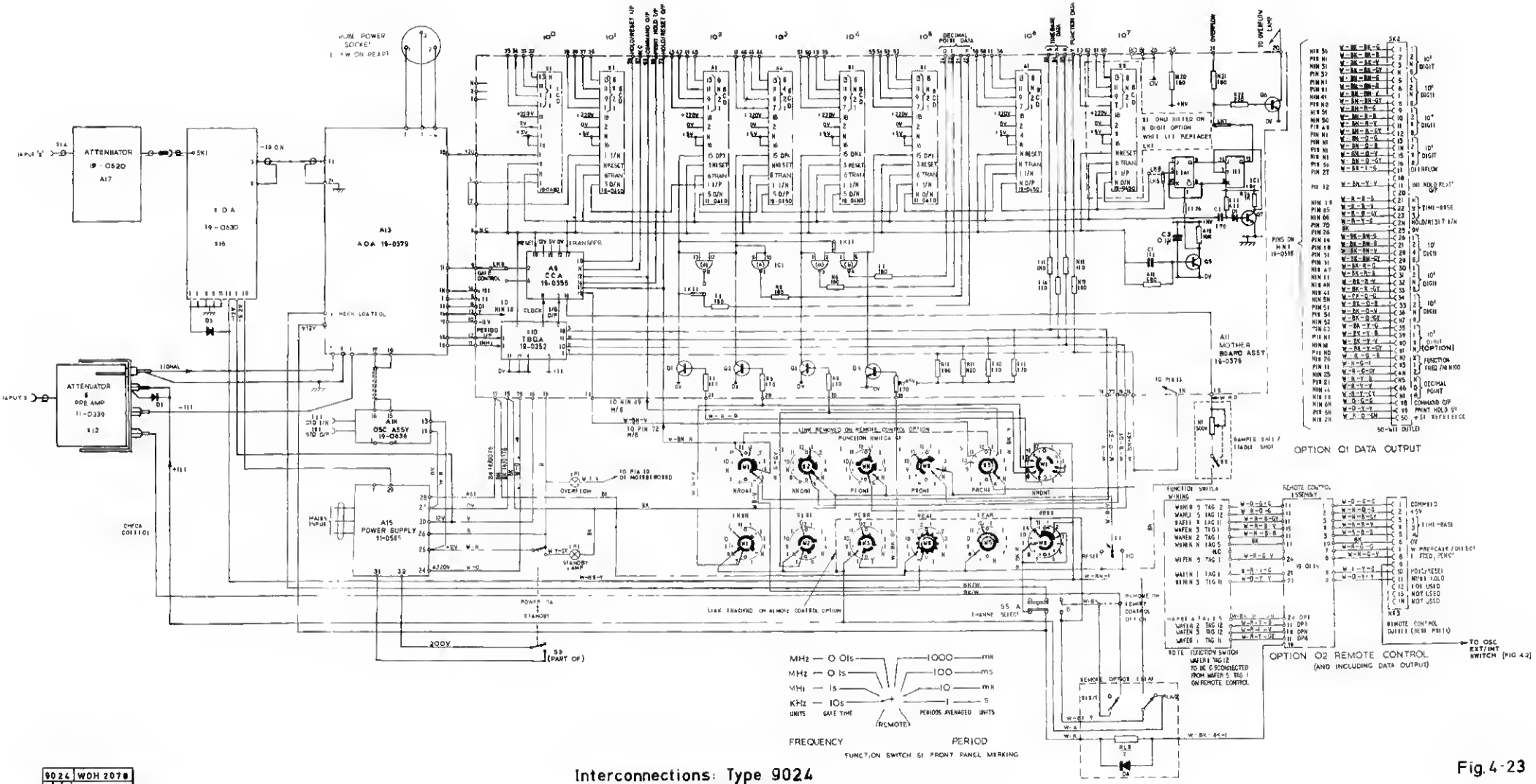
1. THE VALUES OF C17 AND R31 ARE SELECTED BY TEST FROM THE FOLLOWING RANGES
   C17 ---- 10~22p
   R31 ---- 15~33Ω
2. C36 IS FITTED BY TEST

WOM 2078 | 19-0630
1 2 3 4

Circuit: Amplifier Divider Assembly 19-0630

19-0630 Fig. 4·21


LK25
LK1
IC
IC2
LK26
LK23
R1
Q1
R3
Q2
R5
Q3
R7
Q4
R19
R24
Q7
D1
C2
Q5
C1
R18
R21
R22
Q6
R2
R4
R6
R8
R20
LK3
LK21
LK20
LK4
LK19
LK9
LK12
LK11
LK13
LK14
LK15
LK16
LK18
LK17
LK5
LK10
LK8
LK22
R17
R13
R12
R14
R15
R16
R11
R10
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
19-0634/
NOTE:
LINKS SHOWN THUS ----
ARE NOT FITTED IN THE 9024



Interconnections: Type 9024

Fig. 4-23

FREQUENCY PERIOD METER 9024

AMENDMENT

Power Supply Assembly 11-0565 (Fig. 4.3)

In some models, on the Stabilizer P.C.B. 19-0433, R14 has a value and connection details different from those given in the handbook. Also Q5 differs in type.

If R14 is found on inspection to have a value of 56 ohm then its circuit connection is between Q5 collector and the +12V rail to pin 26. The Part Number of the resistor is 20-2560. Also, with the 56 ohm resistor the correct transistor for Q5 is a type 2N2369 (Part No. 22-6017).

If R14 has a value of 10 ohm, then the connection details are as shown in the handbook and Q5 will be a type BFY51 (Part No. 22-6044) as listed on page 7.11.

APPENDIX 1

OPTION 01: DATA (B.C.D.) OUTPUT

For the logic details of Option 01 reference should be made to Page 7 of the Technical Specification at the front of the handbook. The interconnection details are given in Fig.4.23, from which it is seen that in addition to the display data, information is also available from the time base and function selection. The provision of overflow and decimal point information is also included in this comprehensive data readout.

The Data Output Assembly Type 11-0650 consists of a cableform with a 50-way socket for which provision is made by an aperture on the rear panel. See page 7-18 for parts details.

APPENDIX 2

OPTION 02: REMOTE CONTROL AND DATA OUTPUT

This Option comprises the following items:-

(a) Data Output Assembly 11-0650 (see Option 01).

(b) Remote Control P.C.B. Assembly 19-0628 (Fig.4.19).

(c) Relay RLA
(d) Diode D4
(e) Remote Control Outlet Socket.

} (Fig. 4. 23)

The wiring details are given in the lower right hand corner of Fig.4.23, in addition to which, note that three links are removed when fitting this option, they are:-

(a) From the Function switch between wafer 1 Tag 12 and wafer 5 Tag 1.

(b) From the Function switch between wafer 3 tag 8 and wafer 6 tag 12.

(c) The link which normally completes the loop now provided by contact RLA1 of the relay.

OPTION 02 (continued)

For logic details refer to pages 8 and 9 of the Technical Specification at the front af the handbaok.

Remote Control P.C.B. Assembly 19-0628

The circuit of this assembly is shown in Fig.4.19 and the location in Fig.2.7. Referring ta Fig.4.19 it is seen that the board contains a number of "interface" transistors (Q1 to Q5) and a gating network IC1 to IC5. The function of transistors Q1 to Q5 is to render it unnecessary far the customer's logic levels to match those of the instrument, '0' levels down to -20V and '1' levels to +10V being acceptable.

Remote Programming of Frequency Standard

Refer to Technical Specificatian page 9 for logic data and to Chapter 5 para 5.17 for technical description. Circuit details are shown in Fig. 4.2 The only part af Optian 02 which is necessary for this facility is the 14-way autlet socket via which the control logic may be applied.

APPENDIX 3

OPTION 04: ALTERNATIVE TYPE OF FREQUENCY STANDARD

The technical details of Option 04 Alternative Frequency Standard (Racal Type 9420) refer to para.1.5 of the Technical Specification at the front of the handbook. The oscillator plugs into the B7G valve base on the Oscillator p.c.b. Assembly and no circuit changes are necessary other than to check that the link LK1 or LK2 on the oscillator P.C.B. is correctly connected (Refer to Section 2, Chapter 5, para.5.18).

APPENDIX 4

OPTION 06: EIGHT DIGIT READOUT

Option 06 Eight Digit Readout requires the fitting of an additional Standard Reodout Assembly 19-0450 (For technical details refer to Section 2, Chapter 5, Para. 5.48). The Standard Readout Assembly plugs into the vacant edge connector socket on the Mother-board. (See Service View, Fig.2.7). The link LK6 must replace Link LK5 on the Mother-board Assembly as shown on Fig. 4.23.